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CREATIVE MINDS
IN
MEDICINE

BARON LARREY

CREATIVE MINDS
IN
MEDICINE

Scientific, Humanistic, and Cultural Contributions by Physicians

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To the Memory of

Charles Scott Sherrington
Charles Singer
John Farquhar Fulton

If the science of medicine is not to be lowered to the rank of a mere mechanical profession it must preoccupy itself with its history . . . The pursuit of the development of the human mind, this is the role of the historian.

EMILE LITTRÉ

Nightingale Chapter VIII deals with *contributions to medical science by general practitioners,* like Jenner, Koch, Withering, Duroziez, and James Mackenzie, Chapter IX continues on from the author's earlier book entitled *Young Endeavor* and presents more *scientific contributions by medical undergraduates,* among them Bigelow, Cushing, Penfield, Taussig, Theobald Smith, Warren, and John Fulton, while Chapter X covers a host of *medical contributors to music and literature,* listing among others Paracelsus, Auenbrugger, Withering, Laennec, Berlioz, and Damrosch in music, and Garth, Darwin, Smollett, Mitchell, and Osler in literature

Finally, Chapter I contains a fascinating *biography of Baron Larrey,* surgeon to Napoleon's armies and a pioneer in military surgery, with a background of the extraordinary times in which he lived, the French Revolution and Napoleon's campaigns occurring in his middle years

With these essays as illustrations and my own interest in the history of medicine as an excuse I have been permitted by Professor Gibson to present in this Foreword a few succinct impressions of the general evolution of our medical knowledge which I hope will supplement or indeed complement the individual essays In the first place it has become obvious to me and is well illustrated in the present volume that *important discoveries do not come de novo,* that is, out of space They are all a part of a complicated ladder with many rungs in parallel strips but of various widths and space intervals in time and relationships Sometimes three or four rungs of varying importance and of different disciplines lead to a single complete rung representing a new concept or natural law Thus a great new truth is not suddenly born out of the blue An impressive example of this is William Harvey's discovery of the Circulation of the Blood based in major part on what he learned in northern Italy where he studied from 1599 to 1603

A related subject that has intrigued me through the years

is that of the uncertainty of *priority*, and one should not be overconcerned about it There are many examples of this One of them is *chronic constrictive pericarditis* described by Pick in 1896 and named after him without the realization until twenty-five years ago that it had been well described by Sir Samuel Wilks of Guy's Hospital of London in 1870 and before him by Dr Chevers also of Guy's Hospital in 1842 and before him by Lower in the late 1600's The *use of quinine for obstinate arrhythmia* was mentioned as current practice by Senac in 1749 and rediscovered by a patient of Wenckebach in 1914 *Digitalis* introduced as an emetic by Fuchs in 1542 was found to help heart failure by a patient of Withering in 1775, and confirmed by Withering himself in 1785, it then fell into the discard and almost into oblivion until the early years of the present century when Withering's clear directions were resurrected *Jugular pulsation* as a sign of failure of the right side of the heart, described by Lancisi in the early 1700's, was rediscovered by Mackenzie nearly 200 years later And *coronary occlusion* described at autopsy in 1700 in the second edition of Bonet's *Sepulchretum* and further noted by Lancisi in his *De Subitaneis Mortibus* in 1706 was later described as a cause of angina pectoris (a symptom "coined" by Heberden in 1768) by Jenner in the late 1700's, and yet over one hundred years went by before it was solidly introduced as a clinical syndrome by Herrick in 1912

An important step in the evolution of our knowledge usually unheralded and its author unsung has been the correction of important errors A good example of this is found in the *Spicilegium* of Kerckring published in 1670 in which the author apologizes to his professors and other authorities in correcting a grievous error of theirs By one stroke of his pen he erased half of all the "heart disease" of that day by calling postmortem clots what they were instead of polyps or "worms" in the heart responsible for serious disease

Next to my last comment concerns the *difficulties of our*

medical ancestors and the handicaps under which they worked, explaining in large measure at least, if not in toto, the very slow evolution of scientific medicine through the middle ages and actually up to the beginning of the present century The first of these handicaps was that of the short lives and invalidism, from tuberculosis and other plagues, of the doctors themselves who were no more fortunate in escaping these perils than was anyone else A second handicap still with us, though not so constantly, were the wars and political and religious persecutions which shortened the lives of, or put into dungeons, brilliant young physicians undertaking pioneer studies not approved by church or state A third difficulty was that of travel (to make contacts with other physicians) which was not only slow and expensive but often dangerous as noted in the *Cloister and the Hearth* which is well worth rereading in this connection A fourth handicap was that of the expense and difficulties of publication Long after printing was introduced most of the teaching and reporting of new knowledge was done by word of mouth or by laborious writing of manuscripts Several noted authors like Bonet in the 1670's and Mayow about the same time first published small tracts or chapters in order to find out whether or not it would be profitable to prepare larger volumes And a fifth handicap was that of the very limited medical reading public, I believe that the important discoveries made by Lancisi from the autopsies on the bodies of persons dying suddenly in Rome in the winter of 1705 to 1706 would have been recognized as such had the book which he wrote, *De Subitaneis Mortibus*, been written in the vernacular or in easier Latin or had had at least wider circulation

And now, in closing this Foreword, may I urge a partial return at least to a profitable technic of medical education in this country in colonial days, before the establishment of medical schools, I mean the apprentice or tutorial system of assigning a senior medical student to some wise, older and experienced physician, whether in the general or specialty

practice of medicine, or in some other of the many medical vocations now available

It is my hope that these additional comments of mine may prove to be a helpful supplement to Professor Gibson's volume of historical medical essays

PAUL DUDLEY WHITE, M D

Introduction

THE human factor in discovery is the vital, if intangible element which surpasses all others in importance. The present collection of lectures, given recently while Visiting Professor of the History of Medicine at Yale University, does not consciously seek to examine the creative resources nor the basis for the curiosity of the entire group of medical men discussed. Rather, it was the object of these essays to bring forward some neglected but important chapters in the history of a great and humanizing profession.

As I emphasized in my earlier volume *Young Endeavour,* the youth of contributors is of considerable importance. It has been so in non medical fields, also, where we find, for instance, an undergraduate at Amherst College, Arthur V. Davis, and an undergraduate at Oberlin College, Charles Martin Hall, preparing to introduce aluminum to the world as a metal of versatility and economy. They had a concept, and its application is changing the world in many ways. Similarly, the thirty-one year old Swiss, Henri Dunant, as he watched the Battle of Solferino on June 24, 1859, grasped the inadequacy of the medical care provided for wounded soldiers and vowed that he would remedy this. Within five years his work resulted in the foundation of the Red Cross Organization.

The quality of "creativity" which marks the life of a discoverer of scientific truth is possibly of a very different order from that which has characterized the lives of some of the musicians and writers mentioned in these pages. For, as Francis Bacon so aptly put it, "Nature can be ruled only by being obeyed." Or, as John Macmurray used to tell us as

students in England, "Science can only serve, it cannot lead" Thus, inventiveness to meet a need is one thing, yet creative expression another

As one surveys the current social scene one wonders *where* this creative curiosity can gain both foothold and nourish ment Certainly, only as it prospers shall we prosper We must ask ourselves, therefore, "Are we ready to reward crea tive curiosity, or have we still nothing but praise for it?'

Doubtless Pasteur's dictum is right, that "fortune favors the prepared mind" But the question still requiring a searching answer is this "Are we preparing our best minds?" Even the small fraction of them currently arriving at university will find, alas, that faculty committee work— that meeting of parasitic minds"—will rob them of their best hours with their best teachers Students may be excused for thinking that some of our best professors are expected to do the state's thinking for it, while attached for quarters and rations to our universities

Perhaps, however, sanity is in sight, and we shall yet discover the community of scholars in our midst, propelled as they are by creative curiosity Perhaps we shall find, too, students who subscribe to the views of Rudolf Virchow, expressed in his matriculation essay of over a century ago, "A life of painstaking work is not a burden but a blessing Lit tle did his high school teachers know that his eighty one years would be filled with work of the highest scientific calibre, and that his fight for social justice would yield untold blessings Let us, too, think of the blacksmith's son Michael Faraday, getting his education by reading the books he was apprenticed to bind! What curiosity, and what creativeness!

Complacency and progress are so completely antithetical that we would do well, as students and professors in a favoured part of the world, to recall the warning in Fuller's Holy Warre (1639) "Good is not good when proceeding from those from whom farre better is expected"

The Author's thanks are due to the Editors of the *New England Journal of Medicine, Journal of the American Medical Association, Connecticut Medicine,* and *Journal of the History of Medicine and Allied Sciences,* for permission to use in part some of the author's papers which they have already published To Doctor Paul Dudley White, the author is greatly indebted for his Foreword to this volume

Grateful acknowledgment is made of the ever present assistance in the preparation of these lectures, of my wife, Dr N A M MacKenzie, Senator S S McKeen, Dr Herbert Thoms, Lucia Fulton, Madeline Stanton, Elizabeth Thomson, Mary Wheeler and Susan Calthrop

W C G

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CREATIVE MINDS
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Chapter I

Baron Larrey, Surgeon to Napoleon's Armies (1766–1842)

There is one man I envied after reading his works, as a pupil envies his master. That man was Jean Dominique Baron Larrey, Napoleon's physician-in-ordinary. His description of the course of an operation is one of the greatest narratives in the history of medicine, and I am convinced that not twice in a thousand years does mankind produce such a doctor.

FERDINAND SAUERBRUCH

As ONE scans the names of valorous French soldiers on the base of the Arc de Triomphe in Paris, one is surprised to find that of a surgeon, J. D. Larrey. What was his history?

In the year 1766 Larrey was born at Baudéan in the foothills of the French Pyrenees. His early schooling was under the Abbé Grasset, who was to be his friend and admirer throughout a long life. At the age of 13, Larrey was sent to begin an apprenticeship with his uncle, Alexis Larrey, a teacher of surgery at Toulouse, not far distant. After eight years of good training he went up to Paris hoping to visit one university after another in order to find out what the professors had to say about diseases with which he was already familiar at the clinical level. (In this Larrey was showing himself partial to the method of teaching which Dr. Harvey Cushing used to envisage: clinical observation first, to be followed by laboratory investigation.) However, it was not long before the great teacher Louis, perpetual secretary to the Academy of Medicine, alerted his students to the fact

that naval surgeons were being recruited at Brest for ships intended to assist Holland A great number applied at once, Larrey among them On his journey out to Brest naval base he visited the house at Laval in which the great military surgeon Ambroise Pare had been born in 1510 Such pilgrimages, between battles, were to occupy him for the rest of his life, suggesting that a very thorough grounding in the history of his profession had been received at the hands of his Uncle Alexis at Toulouse

At the neighboring village of Mortagne he had encountered an aged physician who was distraught about a case of strangulated hernia Larrey put his colleague's mind at ease and operated on the case for him—with great self assurance at the age of twenty one When he arrived at Brest he was met by the news that Holland and England had concluded a peace, and that few naval surgeons would be required In the examinations conducted there, he was brought twice before the Board, with the happy result that he was made, even at such a young age, Chief Surgeon of the frigate *Vigilante* He was to sail in the Spring for the New World on a voyage to protect the French fishermen on the Grand Banks off Newfoundland During the months of waiting for the vessel to sail, Larrey busied himself with lectures which he gave to students at Brest, with visits to the ship yards and to the galley slaves One of these, with the name Louis Bourbon aged seventy years, had been imprisoned so long in complete darkness that he had lost day vision, and could only see by night Larrey spent a great deal of time with him and observed that a flute—his only salvation—held against the chest wall in playing, had actually grooved the ribs Larrey was active in performing autopsies also, and found a case of complete transposition of the viscera from right to left He studied navigation, natural history and the geography of the lands to be visited

On May 3, 1788 his ship set out into a storm which nearly destroyed it Larrey mournfully writes a memoir on sea-

sickness, his first of dozens, and says that the "particles' within the brain must suffer concussion in this terrible malady He recommended lying horizontal in a hammock—something which we rediscovered in World War II—and he also thought it worth bandaging the head tightly *

Larrey was later to study motion sickness in passengers in horse-drawn coaches, and in subjects seated on camels There he recommended exercise and music as a cure!

Near Newfoundland Larrey's frigate picked up twenty-one shipwrecked sailors, many with frozen hands and feet, on which he operated Upon reaching Newfoundland, after a voyage of fifty-four days, the ship's company built a number of cabins on shore, a large one for Larrey's sailor patients, and one for himself nearby He took up the growing of green herbs, even in that forbidding land, the better to cope with scurvy in the crew He spent a great deal of time botanizing, hunting caribou, and observing lynx, beaver and their dams, as well as partridge The protective colouration in winter interested him greatly He traded with the Eskimo for furs, and admired their bows and arrows, tipped with barbed bone He studied carefully their needles, also made of bone, and the thread made of gut which they used Their liquor came from the fermented buds of the fir trees A diet of vegetables with the codfish kept down scurvy Mosquitoes had to be repelled at that time of year with face nets, and with a skin covering of camphorated oil Larrey was well pleased with salmon caught below the waterfalls, weighing from fifteen pounds up We are not surprised to read in his memoirs, "I must admit that I quitted this solitude with some regret"

After visiting the English colony at St Johns and the

* Both measures would be consonant with our present knowledge of motion sickness which seems to result from a flood of proprioceptive impulses from the muscles supporting the head assailing the semicircular canals Thus Johnston at the University of Western Ontario has shown that it is difficult to make a man motion sick if his head is fixed upon his trunk by a plaster cast

French colonies, St Pierre and Miquelon, in the Gulf of St Lawrence, they sailed on 23 September 1788, arriving on 31 October in Brest The only two men lost on the voyage had been drowned His crew suffered from many things, but all survived

Back in Paris Larrey hastened to the lectures of Sabatier, who was regarded then as a second Ambroise Pare Within a year Larrey was treating the first injured in the French Revolution Some he saw in Desault's clinic at Hotel Dieu, and others later at Les Invalides This was but a foretaste of what was to come The dreams of peace written into the Constitution of 1791 were short lived, as Leopold and Frederick William met in Berlin and signed a treaty against France The Legislative Assembly in 1792 issued its proclamation ' War against kings Peace with all peoples " Troops began to move towards the Rhine, and Larrey, on the advice of Sabatier, was made Surgeon Major to the Army of the Rhine While waiting for the battles to begin Larrey organized a little medical society for military surgeons near Strasbourg

So much has been written *about* Larrey, and about his first great innovation in the battles of 1792,—the flying ambulances—that he should be allowed to speak for himself

> "I now first discovered the inconveniences to which we were subjected in moving our *ambulances*, or military hospitals The military regulations required that they should always be one league distant from the army The wounded were left on the field, until after the engagement, and were then collected at a convenient spot, to which the *ambulances* repaired as speedily as possible, but the number of wagons interposed between them and the army, and many other difficulties so retarded their progress, that they never arrived in less than twenty four or thirty six hours, so that most of the wounded died for want of assistance Many were wounded at the capture of Spire, and a great part of them fell victims to this incon

venience. This suggested to me that the idea of constructing an *ambulance* in such a manner that it might afford a ready conveyance for the wounded during the battle I was unable to carry my plan into execution until some time after

"At Limbourg, our advanced guard had a brisk engagement with that of the King of Prussia The remoteness of our ambulances deprived the wounded of the requisite attention The superior number of the enemy obliged Houchard to effect his retreat by night, although he had gained the field of battle On the other hand, the commander in chief having received intelligence of the sudden march of a strong column which advanced on the left, prevented this movement by taking an advantageous position between Hoechst and Frankfort We found it impossible to bring off our wounded, who fell into the power of the enemy This misfortune induced me to propose to the general, and to the commissary general, who felt great solicitude for these unfortunate men, the plan of an ambulance, calculated to follow the advanced guard in the same manner as the flying artillery My proposition was accepted, and I was authorized to construct a carriage, which I called the *flying-ambulance* I at first thought of having the wounded conveyed on horses, furnished with paniers, but experience soon convinced me of the insufficiency of this plan I next thought of a carriage, so suspended, as to unite swiftness to solidity and ease I shall give a description of this *ambulance* in my campaign in Italy, in the year 1797" *

In addition, Larrey found time to conduct experiments with galvanic stimulation of the muscles of a recently amputated leg He also undertook the development of cutting surgical needles **

As the French forces advanced up the Rhine, Larrey became heavily pressed by the mounting surgery to be done, in

* See Appendix (a), pp 21–24

** See Appendix (b), pp 24–26

a cruelly cold winter, operating on soldiers who had been stripped by the Prussians of their clothing and left to die on the field In the few diastoles of rest between intense systoles of operating, he found time to do autopsies on men dead of "blast injuries" as we would call them today Though these soldiers showed no external injury Larrey concluded, "The disorders which I constantly found in the internal organs left me no room to doubt the immediate action of this projectile '

Ten days after the execution of Louis XVI, in January 1793, England entered the war on the side of Austria and Prussia, with the result that the French had to fall back from the Rhine Larrey was injured in the left leg but kept operating With treason at the front and anarchy in Paris, the French army wallowed in disorder and disaster until a young general, Hoche, united the troops at the front and put up one of the most fantastic battles on record—a seventeen day nonstop battering at Landau, driving the Austro Prussian forces to Mainz This loss and the severity of the winter may have shaken the Prussians' resolve, for they soon retired from the coalition and made a separate peace By April Larrey was sent for by his superiors in Paris who wished him to complete the organization details of his "ambulances Volantes," and to establish them in the several armies of the Republic

Larrey's ambulances might be varied, according to the ter rain, from eight with two wheels to four with four wheels, the latter being sturdier in mountain passes These vehicles were well furnished inside with dressings In mountainous areas without roads, pack horses and mules were preferred Later, in Syria, camels were used, with a large pannier made of reeds or cane, slung on either side In the Egyptian cam paign, the term flying" meant just that The Arabs were merciless in their pursuit of the retreating wounded, and it took strong animals laden with two wounded men sitting or lying in their panniers, to outdistance their pursuers Larrey's panniers on the camels were too successful in one way He found that in Syria the non medical authorities were misap-

propriating them for their own use, leaving the wounded to suffer

The internist in the French army, Baron Percy, produced a rival affair, looking like an elongated gun-carriage, with ten doctors sitting astride the gun barrel, resembling nothing more than a succession of "ducks" at a rifle range

To complete the story on the flying ambulances, Larrey wrote precise regulations governing the care of the wounded once they had been removed from the front lines The most seriously wounded man had priority Rank meant nothing! Need it be said that morale soared to heights unknown before in war? Larrey's name became a magic word for Everyman, for it brought hope of recovery His name chalked on supplies made them sacred That surely was the test

It can be seen that Larrey would be the scourge of the indolent and the planless In some ways he resembles that other great medical military figure, John Shaw Billings, who as a young officer reported that the American army was "the best fed and the worst housed army in the world" Both, however, were amateurs in invective when compared with Florence Nightingale who wrote, in 1859, "The three things which all but destroyed the army in the Crimea were ignorance, incapacity and useless rules, and the same thing will happen again unless future regulations are framed more intelligently and administered by better informed and more capable officers"

To lighten the load on his flying ambulances Larrey arranged that those with light injuries would go back to a first or second line The severely injured were moved from the front to ruined houses on the battlefield, then to monasteries or public buildings, and so on It was as orderly and realistic as anything can be in battle, but it was based on Larrey's early experience in the Rhine campaign, where, obviously, he had his eyes wide open

Back in Paris, Larrey found time to be married to Charlotte Elizabeth Leroux, whose father had been minister of finance

under Louis XVI Before long Larrey was made Surgeon in Chief of the campaign to take Corsica, and ordered to Toulon He very wisely took the long way round, and visited his old friends of apprenticeship days in Toulouse, and the great and inspiring Medical Faculty at Montpellier Larrey would find it just as delightful and as cultured today as he did in 1794 It should not be forgotten that many of the cases of loss of speech from head injuries, studied by Marc Dax after the Napoleonic wars and reported upon in 1836 at Montpellier, were sent to him by Larrey *

At Toulon, Larrey found the Corsican expedition postponed because of a British blockade of the south coast of France He therefore spent his time in examining prospective naval surgeons, and in investigating the pathology of drowning As preparations came to a full stop he was sent to the Franco Spanish frontier to replace two aged military surgeons attached to the army campaigns then in progress As one drives through the eastern slopes of the Pyrenees today one sees monuments to the ebb and flow of competing rulers in this lovely land Alas, how well known it was to become to eastbound refugees from a twentieth century tyrant in Spain, and to westbound Allied airmen shot down over Vichy France

Larrey had no sooner appeared than he was needed, for the retreating Spaniards mined the stone fortresses which they had occupied, and these exploded with such violence and fire that Larrey had not only amputations to deal with, but also massive burns As long sieges went into the winter, frostbite became his chief problem His experience here was later to serve him well in the most melancholy event in all military history, the retreat from Moscow Early amputation, practised in the Rhine campaign, was by now recognized as lifesaving, and many of Larrey's patients lived to fight again In passing, we should note Larrey's praise for the type of dressings used by the Spaniards

* See Appendix (c), pp 26–28

Larrey was recalled to Toulon after the signing of the peace treaty with Spain, and he now organized surgical teaching, both theoretical and clinical, with physiological demonstrations on animals, and with post mortem examinations on patients who died in the military hospitals Here he wrote his celebrated memoir on anthrax Before long, however, he was appointed Professor of Surgery at the newly opened Paris Military Medical School at Val de Grace To day the spirit of Larrey reigns over this ancient academy, and his statue graces its courtyard The equivalent of the modern clinico pathological conference was one of the integral parts of the early teaching programme there Physiology was taught by animal experiment, while materia medica, botany, chemistry and the arts were also represented

Even this station was short lived and Larrey was sent for by the Commander in Chief of the army in Italy, General Bonaparte Both men had had their troubles with the regime in Paris At one stage Larrey had left Paris in a hurry when he learned that the Revolutionary Tribunal was going to arrest him because at some time in the past he had treated an Austrian prince on the field of battle—so successfully that the recovered prince escaped It is sadly reminiscent of the revolutionaries putting to death the great chemist Lavoisier, of whom they said they had no need, just as Lavoisier had finished proving that workmen needed more calories in their food than did the idle rich, but that the workmen were the very ones unable to afford such food Larrey had another brush with the Paris politicians when they sent him a letter which could be interpreted either as thanking or threatening him They addressed him as Citizen Larrey, and lost no time in praising him for his republicanism, and, only incidentally, for his attentions to suffering humanity He was invited to continue in the same spirit!

Napoleon was not so lucky As a Corsican he was wedded to the south coast of France As Captain Bonaparte, he had driven the English from Toulon As a junior officer he had

been active in fortifying the coast towards Marseille, and in the old Greco-Roman fishing port of Cassis one can still read a marble tablet over a door which says in effect that "Napoleon slept here" in 1792.* On April 9, 1794 Napoleon was arrested at Nice and imprisoned in the big square fort at Antibes by the "Representatives of the People" until 20 August. He was then allowed to rejoin his army. What a different history Europe would have had if in the twenty years from 1794 to 1814 Napoleon had remained in this jail.**

When Larrey arrived at Milan in May 1797 the 12-month campaign in Italy was nearing its close. By October the Austrians had signed the Treaty of Campo-Formio. In the few months which he spent in Italy, Larrey organized several flying ambulances at Napoleon's request, and so successful were they that at the end of the campaign an award of 2,400 livres was made to Larrey. Napoleon wrote to him, "Your work has been one of the most important concepts of this century and alone is sufficient to give you a great reputation." While in Italy Larrey met Scarpa and Spallanzani, and visited such medical shrines as Padua. In the Alps, Larrey described thyroid deficiency in the following terms:

> "In no other part of Europe have I met with a people more miserable than the majority of the inhabitants of Maurienne I have never seen any of so debased a nature, in point of physical powers. Almost all of them are affected with goitre, which deforms the face, and renders its features hideous. To this deformity is added, in many instances, that of the skull, the diminutive size and extreme thickness of which is peculiarly striking. These unfortunate persons are called *Cretins.* They are deprived of in-

* The fort which he built there has been transformed by Jerome Hill, of New York, into an open-air theatre for the distinguished annual festival of Cassis

** Carnot was later to write, "Without mentioning his military disasters, few men have exercised a more pernicious influence on the fate of their country than did Napoleon, despite his prodigious ability, keen judgment, inflexible character and a heart that was brave and often kindly."

telligence, and present all the characters of idiotism These peculiarities appear to proceed from the use of snow-water, the privations to which they are subjected, bad diet, and the unwholesome air which they inspire in their dwellings Their habitations alone give an idea of the idiotick nature of the people They are shapeless cabins, rudely put together, and without doors or chimneys The smoke escapes by an opening in the roof The roof is covered with large thick slates, placed almost horizontally, one on the top of another, in such a manner, that the snow collects on them during the whole winter, and sometimes crushes these rude piles with its weight, and buries their wretched inhabitants A hamlet was pointed out to me, half of which had suffered this hard fate"

By now, Larrey was happy at the prospect of returning to his Chair of Surgery at Val-de Grace He was in time for the opening of the winter term and was well into the dissection when an order came appointing him one of the three surgeons in chief required by the government for the army which was now to invade England! Every other country had been knocked out of the ring, England alone remained Then, with one of those fantastic shifts which leave historians gasping, Napoleon decided to call off the Channel crossing, and to attack Egypt! The parallel with the events of 1941 is remarkable

Thus, Larrey was posted to the Expedition of the Mediterranean as Surgeon-in Chief, and 35,000 picked men were assembled at Toulon Thirty cases full of medical supplies were packed, alas, on one ship Though Nelson missed the French fleet he caught the ship on which the medical supplies were largely carried The lack of them was to be disastrous to the later French effort The fleet first sailed to Malta, which was soon overcome It then proceeded to Alexandria where heavy action began, with many casualties, among them General Kleber The action for Cairo saw Larrey's ambulances almost annihilated by the fierce tribesmen whom they en-

countered Bonaparte fought the Mamelouks at the Battle of the Pyramids in blazing July weather, and had heavy casualties He pursued the Mamelouks toward Syria The sabre cuts suffered by the French were frightful in every close encounter Meanwhile, Larrey turned the Chateau of Gizeh into a hospital and he started classes in surgery, as part of The Institute of Egypt which Napoleon had ordered set up

Soon Turkey declared war over Syria and Larrey found himself immediately in need of camel borne transport for the wounded who must be brought back He developed the panniers already described His first duty was to get to the Syrian battlefields, which he did by riding three days and three nights by camel He found the victims of the Battle of El Aurich lying in the rain on palm leaves! Napoleon plunged on to take the ports of Gaza and Jaffa, providing more injured for Larrey to succour Then came thirteen futile assaults on the sea girt fortress of St Jean d'Acre, which produced 2,000 casualties among the French Though injured himself, Larrey performed seventy amputations He notes that he trephined seven skulls, five patients being eventually restored to health The Turkish army was defeated at Mt Tabor on August 16, 1799, near Nazareth However, news reached Napoleon that 20,000 Turkish troops had landed in Egypt, so the long retreat began He ordered that all horses belonging to the General Staff would transport the wounded, and he and Larrey walked, followed by the other senior officers None of the wounded were lost en route, despite frightful wounds of the head, chest and abdomen Eight hundred travelled overland and another 1,200 by sea

No sooner had they returned than Napoleon attacked the Turks at Aboukir This cost the French 800 more casualties, but Larrey's ambulances were so organized that a delay of only fifteen minutes took place before a wounded man, brought off the battlefield, had his wounds dressed

Napoleon, receiving disquieting news from Paris, returned there and staged his coup d'état. Of this, Larrey wrote to his

wife, "I was very moved when I saw this famous soldier take up the sceptre of kings. Everything tells me that this instrument of tyranny will lead to his downfall and France's ruin." At Napoleon's crowning, by the Pope, a large unmanned balloon bearing an illuminated crown was released by night. It soared over France and crashed on Nero's tomb in Italy.

Meanwhile, the Turks returned to the battle, at Heliopolis, where Larrey's assistant was decapitated by a cannon ball as he worked beside him. General Kleber was assassinated by a fanatical Arab after the battle. As Larrey worked over one victim he did not see the British lancers approaching, and had to shoulder his patient and run to shelter. By the end of August, a poorly led, poorly fed and poorly re-inforced French army sailed for France, with all their wounded on board. Only the reception which Larrey received at Marseille can have made up for the risks and heartbreaks of this utterly futile campaign. Larrey found on arrival three letters of commendation from Paris, where Napoleon had acquainted the officials with this man's heroic efforts and wise planning. The French nation gave Larrey's wife a gift of 1,500 francs. Larrey was made Surgeon-in-Chief of the French army and awarded the Cross of the Chevalier of the Legion of Honour.

Larrey now found time to complete his *Surgical Report on the Army of the East.* He wrote a thesis on amputations, for the degree of Doctor of Surgery, one of the first given in France. Throughout the long and expensive campaign he had kept up his publications, such as the memoirs on ophthalmia, leprosy, elephantiasis, the methods of embalming used by the Egyptians, and another account of the scurvy. His Surgical Report was dedicated to Napoleon, and was well received by all but the most conservative physicians and surgeons.

While Napoleon tightened his grip on the French state he developed some amazing delusions of grandeur, one of which was that, relying on the Spanish and French fleets, he could cross the English Channel victoriously! He massed

80,000 soldiers at Boulogne for the invasion, but the fleets, dispersed and destroyed by Nelson and his confreres, never arrived A column near Boulogne records this large scale attempt to invade the sceptered isle

Through Ulm and Vienna the new Emperor's army marched to the great show down at Austerlitz Napoleon rode through the lines on the anniversary of his crowning and electrified the 80,000 soldiers who held high bundles of burning straw in a torchlight ceremony Little did he know that fire would be his undoing at the end of another ten years of warmaking By dawn the December snow had ceased and the armies attacked, on frozen fields and on frozen lakes No battlefield in history had ever presented such a scene of death and destruction Between 10,000 and 12,000 died on the snow The French took 30,000 prisoners including twenty generals The Russians had abandoned their cannon early in the fight An epidemic soon broke out among the French soldiers as they returned to Paris with their prisoners, and Larrey's hospital arrangements were severely strained With the Peace of Presburg all returned to France, where Larrey found time to write up his studies on aneurysms, spontaneous haemorrhage, and its arrest by low temperatures He knew that scurvy in a soldier militated against coagulation He wrote also on rheumatism, carbon monoxide poisoning and on what he called "cerebral epilepsy," and its differentiation from feigned seizures He mentions ether in its treatment

Then, by September 1806, the campaigns in Saxony and Prussia began After Jena, Napoleon raced for Warsaw on which the Russians were closing swiftly In the cold of February the Battle of Eylau was fought, and Napoleon came close to losing it several times Again his genius for breaking out through the weakest point was demonstrated, but Larrey's ambulances were so menaced that severely wounded soldiers ran from them, rather than risk treatment and im prisonment The instruments were so cold that they could not be held in the hands of his surgeons, yet Larrey, weeping,

continued to amputate shattered limbs long after the battle was over With the Fourth Coalition broken up, the Peace of Tilsit was signed Larrey returned to Paris, after being made a Doctor of Physic at Jena

He was able to write his memoir on dry gangrene from frostbite, in the brief respite which ensued, but soon he was sent off on the disastrous Spanish Campaign Again he took his route through Toulouse where his old friends on the Faculty persuaded him to lecture, or, as he says

> " to undertake the demonstration of the system of Dr Gall which was then a subject of general interest (phrenology) Although I felt a repugnance to say any thing on this new doctrine in a city where the prevailing religious opinions must rise in opposition to it, yet I submitted to the wish of my brethren, and in four hours com pleted an anatomical and physiological demonstration of the encephalon, according to the principles of the German doctor, but with some variations"

He continued on his way through the foothill country of the Pyrenees where he was born, commenting on the little brooks that run beside the streets in the towns and the hot-springs which characterize the mountains Again he describes goitre and cretinism, and adds that chief magistrates should be alerted to the problem From this pleasant countryside Larrey was plunged into more ferocious fighting, more infections and penetrating wounds in the Spanish Campaign He tells of a 12 year old English drummer boy taken prisoner with others at Corunna just as they were to embark The prisoners were all marched through the depth of winter *barefoot* to Valladolid Is it any wonder that Larrey had the drummer boy attached to his hospital where he was cured of an eye affliction, and sent on his way with a little Spanish cloak and some decent clothes? One wonders if the little boy ever made his way safely back to England

Larrey himself went down with typhus and was led along the Burgos road in a delirious state Three weeks after his re

turn to Paris he was called by Napoleon to bring his flying ambulances east to the campaign of the Grande Armee against the Fifth Coalition Thus, he went through to the end of the Battle of Wagram, seeing, as his notes declare, all manner of wounds, the use of cautery in tetanus wounds of the head and neck, amputations at the hip joint, the shoulder joint, through the thigh (which he had to perform on his old friend from the campaigns in Egypt and Syria, the Duke of Montebello), the use of quinine and sulphuric ether in high fevers, and even the making of horseflesh soup, flavoured with a little gunpowder, for the wounded who were cut off from supplies

In the three years of comparative peace which followed, Larrey was able to write his three great volumes *Memoirs of Military Surgery*

Napoleon made each of his four senior medical officers Barons, and gave them pensions of 5,000 francs per year By February of 1812 Larrey was named Surgeon in Chief of the campaign against Russia and proceeded eastward At Berlin he set up a military medical school for the instruction of the large number of surgeons required Ahead of him lay the siege of Smolensk, with its 1,200 dead and 6,000 wounded In 24 hours he did 200 operations It was his worst experience to date Then came the battle for the approaches to Moscow, where forty French generals alone were killed Between 12,000 and 13,000 men were put out of action in this battle, in which 600,000 soldiers took part Larrey treated French and Russian wounded alike Little wonder that the dressings provided were insufficient

Larrey entered a deserted Moscow with Napoleon in mid September, and the soldiers went out to pillage the capital While Napoleon waited for a reply to his terms, sent to Alexander at St Petersburg, he is said to have toyed with the idea of digging in for the winter, and of having a troupe from the Comedie Francaise sent to Moscow for his entertainment As Napoleon watched Moscow burning he told Larrey,

"This sad event is the presage of a long train of disasters" However, on October 19th, which is far too late in northern climates, he decided to wait no longer, but to retreat with the remaining 100,000 of the 400,000 able-bodied men who had entered Russia with him The tragic story of the retreat is too well known to be taken up here, save to say that the winter which they encountered was of such severity that even the pursuing Russians lost three quarters of their men Dissension was rampant in Napoleon's higher command, and his brother-in-law, Murat, left and went home to Naples Wagons and gun carriages carried the sick for a time, but in the winter temperatures men lost their reason or will to live and sank down in a final sleep in the snow Larrey marched with the men all day, and cared for them all night He devised "walking casts" like box splints He arrived at Vilna exhausted, and at Koenigsberg went down with typhus The soldiers had been continually harassed by Cossacks and Larrey had had, even in retreat, much to do

The invasion of France itself followed the campaign in Saxony and in 1814 Napoleon left for Elba Larrey wished to accompany him into exile but Napoleon told him the army needed him more than he did It is incomprehensible that Napoleon's enemies should imagine for a moment that Elba meant exile As one looks at the narrow strait between Elba and Italy from the air, one realizes that any enterprising person in a rowboat could cover the distance to shore in two hours

It is little wonder, therefore, that Napoleon returned to France on May 1, 1815 to begin the Hundred Days, culminating in Waterloo Chance was on Napoleon's side on a number of occasions, such as when the intelligence being sent to Wellington by Colonel Colquhoun Grant as to Napoleon's moves was held up by General Dornberg because he thought it "impossible nonsense" Nevertheless, Napoleon's doom was sealed As Wellington looked out over the gently rolling farms of Waterloo he was staggered to see a French

surgeon with a light ambulance going to the assistance of wounded on the field in the thick of the battle. On being told that this was Larrey he uncovered his head and said: "I salute the honour and loyalty of such a doctor." *

Larrey was wounded, taken prisoner, and was being blindfolded before a firing squad when a German surgeon recognized him. He was taken before Marshal Blucher, whose son he had saved after a battle in Austria. Blucher gave him enough money to make his own way home to France. He was weary after sixty battles in the twenty-five campaigns in which he had served.

When Napoleon's will was read it was found that he had left Larrey 100,000 francs with the statement that, "He was the most virtuous man I ever knew." When Napoleon's ashes were brought to Paris from St. Helena, Larrey, aged seventy-five, turned out on a bitterly cold day to follow them bareheaded to their last resting place at Les Invalides.

Larrey's contributions speak for themselves, in five great volumes.** He was above all a practitioner-teacher, proud of the status of his civilized profession in an uncivilized world, and a keen student of its history. He was of the cut of John Hunter and Ambroise Paré. Perhaps Napoleon's words written on St. Helena best describe him, "He is truly a worthy man, for to science he unites all the virtue of an effective

* Wellington told Lady Shelby, "It is quite impossible to think of glory. Both mind and feelings are exhausted I am wretched even in the moment of victory, and I always say that next to a battle lost the greatest misery is a battle gained "

** Sauerbruch, Germany's outstanding military surgeon, wrote in 1953, "After the retreat across the Beresina, he, as head surgeon of the Grande Armée, had performed two hundred and thirty four amputations of frozen limbs in the course of one night Exhausted by this herculean task and staggering under its overpowering spiritual burden, he threw himself down to sleep, but in vain. He wrote a few sentences in his notebook, thoughts that had occurred to him during that night. One of them electrified me 'The muscles left in the stump should be used for the movements of an artificial hand' "

philanthropist All the wounded are his family. . If the army were to raise a column to the memory of anyone, it should be to that of Larrey"

The great American surgeon, Valentine Mott, in his "Travels," published in 1842, the year of Larrey's death, gives us an intimate picture of the old campaigner still at work

> "Did ever any man, in ancient or modern times, witness one tenth or one hundredth part of the bloody scenes of battle that he has participated in? What Surgeon has ever looked upon, and been in the midst of such awful carnage? From the burning sands of Egypt to the frozen snows of Russia, and the final close of the drama at Waterloo he was ever by the side of his beloved chieftain I very much question whether any man since the days of Ambroise Paré ever enjoyed the confidence and esteem of the whole army as much as Larrey This I myself have witnessed again and again in his walks through the hospital of the celebrated *Invalides* at Paris The eyes of those decrepit warriors would glisten with joy at his approach, and, if sad from suffering, he would cheer their drooping spirits by recounting to them some memorable victory in which they had both participated I have heard him sound in their ears the magic words *Lodi, Marengo, Austerlitz* and *Mont Tabor,* and the effect was electric and wonderful"

Thus we leave a great humanitarian, with so much more to say about him, unsaid Would that we could bring Larrey's life before many more students, in whatever land, lest we forget this ornament of the medical profession and benefactor of the sick and wounded

Appendix (a)

"The following is a description of the *ambulance* used in Italy

FLYING AMBULANCE

This *ambulance* which may be distinguished by the name of *century,** was made up of three divisions The first was at Udino, the second at Padua, and the third at Milan

Each of these was arranged in the following manner

One surgeon major of the first class, commanding with two senior surgeon's mates of the second class,

Twelve junior surgeon's mates of the third class, two of them serving as apothecaries,

A lieutenant, steward of division of *ambulance,*

A sub lieutenant, inspector of police, acting as under steward,

A quarter master general, of the first class of *ambulance,*

Two deputies of the third class of *ambulance,*

A bearer of surgical instruments, with a trumpet,

Twelve soldiers on horseback, as overseers to take care of the wounded, among them a farrier, a saddler, and a boot-maker,

A commissioned serjeant major of the first class,

Two commissioned officers of the second class to precede the *ambulance,*

Three corporals, retained for the performance of various errands,

A lad, with a drum, carrying surgical dressings,

Twenty five foot soldiers, as overseers to take care of the wounded

There were twelve light and four heavy carriages to a division

This number of carriages required —

A quarter master general as director,

An assistant quarter master,

Two brigadiers, one of whom was a farrier,

A trumpet,

Five soldiers, as guides,

* A name lately given them by Baron Percy

Total number of men attached to each division of *ambulance,* 113

The whole legion, including the chief surgeon commanding, 340

The uniform of the surgeons of the flying ambulance was made like that of the army surgeons, they carried a small cartouche box of black morocco, slightly ornamented, divided into several compartments, containing a case of portable surgical instruments, some medicines, and articles necessary for affording immediate assistance to the wounded, on the field of battle, they wore a sword with a black leather belt

The uniforms of the commissioned and non commissioned officers were of different colours, ornamented according to their grade The commissioned officers wore epaulets

The infantry and mounted overseers who were appointed to take care of the wounded, wore a short uniform coat with a red woolen sash which served, in case of necessity, to carry off the wounded The mounted overseers wore small cloak-riding coats and the infantry cloaks, the former wore hussar boots, the latter strong shoes and black cloth guetres, their hats were of black felt, ornamented with leather and brass, each mounted overseer carried a black leather cartouche box, containing one or two plates, a tin goblet, and the utensils for dressing the wounds of the horse, they wore a small sabre with a chamois leather belt The overseers on foot carried a leather belt divided into several compartments, containing the dressings that were held in reserve by the surgeons

The uniform of the common soldiers was nearly the same, but more simple, and made of coarser cloth

The different classes of these soldiers were distinguished by the colour of the cape, as well as the ornaments of the coat

The trappings of a horse belonging to an officer of the medical staff, were, a French saddle, with a cloth similar in colour to the uniform of the rider, edged with gold lace of various extent, according to the grade of the officer Instead

of holsters for pistols, I supplied them with couriers' bags, which were more useful they were covered with a holster-cap, edged with lace A small leather portmanteau was also fixed to the saddle This portmanteau contained dressings and might be easily opened without loosing the straps which made it fast to the saddle"

Appendix (b)

"I profitted by this leisure to attend the anatomical labours of Dr Soemmering, and to repeat, with Dr Strak, the first experiments that had been made in galvanism After many experiments on inferior animals, I wished to make them on the human subject An accident happened to one of our soldiers which gave me an opportunity.

"An artillery-carriage passed over a soldier's leg, and produced an injury of the knee, which required an amputation above it The limb being removed, I confided the tyeing of the vessels and the dressing to a careful assistant, in order to engage immediately in a galvanick experiment I first dissected the popliteal nerve, the trunk of which I insulated at its first branches Having armed this nerve with a thin leaden plate, and laid bare the belly of the gastrocnemii muscles, I took a piece of silver in each hand, and touched with one piece the leaden plate, and put the other in contact with the muscles, and very strong convulsive motions were produced, which agitated the leg and foot Dr Strak repeated the experiment, but pieces of iron and steel did not produce such obvious phenomena The effects were singularly increased, when we used a curved silver probe as a conductor, although the animal heat was by this time considerably diminished *

"The result of these experiments led me to believe that on conveying the galvanick or electrick fluid to the naked subcutaneous filaments of the nerves, that paralyzed limbs might

* A great number of extremely curious experiments analogous to mine, and those of Galvani may be found in the History of Galvanism by Dr Sue, principal physician to the Hospital of the Guards

be restored to their natural functions Before attempting this experiment, I submitted this opinion to the Philomatick Society, at the same time describing my experiment on the amputated leg The unimportant advantages which have been since derived from galvanism and electricity in the cure of various diseases, have led me to renounce my plan, and the question remains yet undecided

"Previous to my departure from Paris, while at the practical school, I invented a needle of a peculiar construction, for sutures The success with which I used it in our first campaign in a number of cases, induced me to make it the subject of a short memoir, which I addressed to the Royal Academy of Surgery, who were then discussing a question of long standing, on instruments of this description

"The academy received my memoir favourably, as well as the model of the needle, and decreed me a gold medal of 100 livres value

"The publication of the transactions of this academy having been suspended since the death of its secretary M Louis, my memoir has not yet been printed I shall therefore give a short extract from it

"I first attempted to point out the inconveniences of the needles hitherto in use, I then described mine, and explained its advantages It is made of fine and well tempered steel, it is necessary to have them of various sizes for different parts It is curved so as to form a semi circle, with parallel extremities, the point resembles a small lance or pike, slightly curved, and acute with sharp edges The edges terminate towards the body of the needle in two obtuse angles, more or less salient according to the size of the instrument Its body is of a uniform thickness and size, polished on both its surfaces —Its edges are rounded, and rather thinner than the middle

"Its heel is pierced by a square transverse opening, at a short distance from the extremity, and contains a smooth groove for receiving the cord or ribbon These needles pass

easily through the skin, and the ligature or ribbon is perfectly free, retains its flattened form, and thus supports the lips of the wound The slight wounds occasioned by these needles, are *never attended with danger, and* when the ribbon is extracted, they quickly cicatrize

"In comparing these needles with those of the ancients and moderns, the difference will be apparent, these pass easily through the thick and elastick membranes of the skin, and produce wounds similar only to those which follow the use of the lancet

"I have frequently used these needles, and always with complete success

"I also presented to the academy a needle for aneurism It differs from the first only in the form of the point, which is blunt, thin and rounded, so that it may penetrate the cellular substance with facility, while it cannot wound the nervous cords, nor cut the collateral branches of the arteries which are to be tied The opening for the reception of the ligature is formed in the same manner as that of the needle for suture The needle for ligature is made flexible, in order to pass without difficulty in the indirect course it sometimes has to pursue"

Appendix (c)

"Among the wounded of the line who were not able to bear the transportation from Reneveck to Vienna, and were therefore united to the wounded of the guard under my care, was a remarkable case I could not learn the name of the young man (about twenty-one years of age), as he had lost all his senses, and almost all his animal faculties The organick functions were still nearly in their natural state He had been wounded in the battle of Eslingen by a ball, and a fistulous wound remained in his left temple, near the orbit of the eye The eye of the same side projected outwardly, and had entirely lost its powers But he could still discern light and large objects with the right eye The left half of the

cranium was evidently more arched and voluminous than the right When the temporal region was examined by the eye or touch, a space as large as the finger was perceived to extend upwards and backwards, in a semicircular manner, along the course of the coronal, as far as its junction with the sagittal suture It was evident that this space, in which the finger could be placed, was produced by a separation of the frontal and parietal bones

"Authors give us many cases of the separation of the bones or sutures of the cranium, followed generally by death before the ninth day after the accident But I never saw a case like this, in which the patient survived beyond the ninth day We shall be better prepared to appreciate the resources of nature in such cases, when the appearances are given which we discovered on opening his cranium after he died of the hospital fever, then very general in our wards At that time, his wound was nearly healed

"This man always continued lying in bed, and seldom moved, in consequence of the paralysis of his muscles His appetite and digestion were good Respiration, circulation, and secretions, continued to be regularly performed

"After examining the head carefully, and probing the wound, I discovered a hard body deeply seated near the orbitary sinus I dilated the superiour part of the sinus, and with a strong pair of pincers extracted the ball It was then moveable, though at first it was firmly fixed in the bone

"After extracting this ball, which was irregularly flattened, I discovered a deep cavity, and felt the pulsation of the brain The wound was dressed superficially with dry lint, and he took bark, wine, and antispasmodicks

"After this operation, which was in August, he appeared to improve, and the enlargement of the suture seemed to diminish gradually When I set out for France, about the first of November, we were in expectation of his recovery five months had now elapsed since he was wounded After the ball was extracted, he talked like a child which is just be-

ginning to stammer for example, he expressed an affirmative by the word *baba,* and the negative by *lala,* and when he asked for any thing, he forcibly pronounced the words *dada* or *tata* About the beginning of December, of the same year, he fell a victim of the hospital fever

'The surgeon of the hospital at Reneveck was so obliging as to send the head of this man to Paris, in a cask filled with a solution of hyper oxygenated muriate of mercury

Mr Aumont, an expert hospital surgeon of the guards, proceeded to dissect it in my presence The integuments and soft parts about the cranium being carefully removed, he divided this bony case vertically, from side to side, that we might be able to see the disorder occasioned by the ball in its anteriour part We found the dura mater strongly adhering to the sutures it had acquired great thickness and strength along the parieto frontal suture, which was dilated The circumvolutions of the brain contiguous to the fracture were effaced, and the membranes covering this portion of the cerebrum were also very thick and adhered to each other After detaching these membranes and raising up the brain, we discovered an aperture in the frontal, below the angle of the temporal bone, and behind the external angular apophysis"

Chapter II

Contributions by Doctors to Social Progress

The physicians are the natural attorneys of the poor, and social problems fall to a large extent within their jurisdiction

RUDOLF VIRCHOW

IT MAY seem slightly anomalous to speak of medical contributions to social progress, since, it can be argued, the day to day care of patients in whatever part of the world is, in truth, such a contribution What will be discussed, however, in this chapter are the special arrangements or methods by which certain farsighted physicians have sought to bring the blessings of medical science more fully to large groups of people For this reason the subject will be treated under such subdivisions as early attempts to provide care at dispensaries, social and economic reforms urged by physicians in the hope of relieving much of the basis of illness in the past, and parliamentary reforms designed to alleviate the cruder forms of human misery The political careers of some famous figures in medical history, the great epics in preventive medicine, and the medical pioneers in research in social medicine, will be followed by a consideration of the future relationships between medical knowledge and criminal responsibility before the law, with a brief final section on the future of scientific medicine as modified by the methods of providing medical care

The felicitous pen of Harvey Cushing was never better ap-

plied to medical and social history than in his classic description of *Dr. Garth, The Kit-Kat Poet* (1661–1718). The forty-eight worthies who associated together at London's "Cat and Fiddle" tavern operated by one Christopher or "Kit" for short, numbered among them some outstanding scholars and wits. Dryden, Steele and Thomas Moore were Dr. Garth's supporters in one of the sharp clashes between the Physicians of London and their Apothecary rivals. These latter were once associated with The Grocers in all manner of medical exploits, phlebotomizing people in great numbers, for bloodletting was one of the panaceas of the time. However, the partnership was not always a happy one, for the Grocers "cut" the drugs, or adulterated them with ingredients which were worthless, and, we can only hope, harmless. This eventually led to an Act placing the Apothecaries under the thumb of the Physicians. The Apothecaries, naturally, resented this and proceeded to undercut the Physicians' fees, allegedly to help the poor!

In the year 1687, the Physicians, therefore, decided to open Dispensaries at which they could prescribe for the sick poor.* The Apothecaries replied by increasing the price of the medicines so prescribed, to spite both the Physicians *and* the poor! Thereupon the Physicians prepared in their own College laboratory all the medicines which they dispensed. The Apothecaries' tart rejoinder was that the Physicians were doing this in order to pocket the profits! It was really a charming display of brotherly love, all in the cause of helping the sick and needy.

Certain doubts began to assail the more conservative members of the College of Physicians, who really wanted no part of "the poor of London," and these became known as Anti-Dispensarians. They were tough-minded Fellows, such as

* In Paris, the first medical dispensary was organized by the physician to Louis XIII, Théophraste Renaudot (1586–1653), who in 1630 originated the first labor exchange, in 1631 the first French newspaper, and later the first pawn shop!

Sir Richard Blackmore He was lampooned by Garth's friend, Thomas Moore, thus

"'Twas in his carriage the sublime
Sir Richard Blackmore used to rhyme,
And if the wits don't do him wrong,
'twixt death and epics passed his time
Scribbling and killing all day long"

The Dispensarian members of the College of Physicians included such eminent men and public benefactors as Sir Hans Sloane The poet Dryden wrote

"Garth, generous as his muse, prescribes and gives
The shopman sells, and by destruction lives
Ungrateful tribe! who like the viper's brood,
From Medicine issuing, suck their mother s blood!
Let these obey and let the learned prescribe,
That men may die without a double bribe,
Let them, but under their superiors kill,
When doctors first have signed the bloody bill
He 'scapes the best, who, nature to repair,
Draws physic from the fields in draughts of vital air"

Garth's poem, 'The Dispensary," is thus a chronicle of the first serious attempt by an organized and official group of the medical profession to open outpatient clinics for the free treatment of the sick His poem, in six cantos, went through ten authorized editions in all, plus a few unauthorized! Horace Walpole was very impressed with both the poetry and the social conscience of Garth and his friends Steele, in dedicating his play *The Lover* to him, wrote, 'The pitiful artifices which empirics are guilty of, to drain cash out of valetudinarians are the abhorence of your generous mind"

We are not surprised to find Garth, between outpatients, writing the Prologue for the opening of the famous Haymarket Opera House designed by Vanbrugh

Garth's saving grace was his sense of humour and his spicy imagination. He pictures in his poem an imaginary battle in

the streets of London between the pro- and anti-Dispensarians thus

"The deadly drugs in double doses fly,
And pestles peal a martial symphony
Now from their level'd syringes they pour
The liquid volley of a missive show'r"

Dispensaries came to be set up in many parts of England John Lettsom, the Quaker physician, opened The General Dispensary. Thomas Dover, *the pirate, immortalized in Dover's Powder*, was the first in Bristol to give systematic treatment to the poor. Later, Dr Thomas Beddoes, at his Pneumatical Institution in Bristol, opened the first day hospital as we now know it It was in this pioneer clinical investigation unit that Humphry Davy was made superintendent of researches at the tender age of nineteen years, here to discover the anaesthetic possibilities of nitrous oxide, which, not knowing its own history, a profession promptly cast into oblivion Beddoes, though odd in many ways, was truly a compassionate man He sought to free women from the heavy manual labour of washdays, and wrote

> "Can no genius invent a machine by which opulent neighbours, attentive to their hard fated creatures, may be able to relieve some of them from this destructive drudgery?"

Medical men saw the pressing social needs of the people, and when they could, they remedied them from their own pocket Captain Coram set up his Foundling Hospital in London near the site of the present Hospital for Sick Children, and it is pleasant to see his name memorialized in Coram's Fields, a beautiful park enjoyed both by children and post-graduate medical students in London *And this* spirit is not dead, as witness the development in 1945 of post-war Children's Villages by a medical undergraduate at Innsbruck, Hermann Gmeiner Most European countries have

followed with these 'Villages d'enfants S O S." as they are called

This same drive to present the fruits of medical science to the needy characterized the life of the Reverend Peter Parker, M D , of Yale, when, fresh from his didactic training in New Haven he sailed for China, there to set up an Eye Dispensary of some magnitude Here is his own description of it.

"Encouraged by the success of a dispensary at Singapore for the benefit of the Chinese, where, from the first of January, 1835, to the following August, more than 1000 were received, it was resolved, on my return to Canton, to open a similar institution here After some delay the factory No 7 in Fungtaehong was rented of Howgua, the senior member of the Cohong, at $500 00 per annum Its retired situation and direct communication with a street, so that patients could come and go without annoying foreigners by passing through their hongs, or excite observation of the natives by being seen to resort to a foreigner's house, rendered it a most suitable place for the purpose Besides a large room in the second story, where 200 may be comfortably seated and prescribed for, the house can afford temporary lodgings for at least forty patients The anticipation that a single class of diseases would furnish full employment for one physician was soon realized and patients, in great numbers have been sent away, because no more could be received at one time

"The regulations of the hospital are few and simple The porter is furnished with slips of bamboo, which are numbered both in Chinese and English One of these is a passport to the room above, where patients are treated in the order of their arrival The name of each new patient, the disease, number (reckoning from the opening of the hospital), time of admission, etc are recorded A card containing these particulars is given to the patient who retains it until discharged from the hospital, it always entitling the bearer to one of the slips of bamboo from the porter The prescription is written on a slip of paper, and

this, being filed in the order of its number, as soon as the patient again presents his card, is referred to, the previous treatment seen, and new directions are added In this way about 200 have been prescribed for in a day Thursdays are set apart for operations for cataracts, entropia, pterygia, and other surgical cases

"Difficulty was anticipated in receiving females as house patients, it being regarded as illegal for a female to enter the foreign factories, but the difficulty was proved more imaginary than real Those whose case required them to remain have been attended by some responsible relative—wives by husbands, mothers by sons, daughters by their brothers, and it has been truly gratifying to see the vigilance with which these relative duties have been performed The more wealthy have been attended by two, three, or four servants and have provided for them selves Those who were unable to meet expenses have *had their board gratuitously*"

The dispensaries, which Garth and his like opened for the treatment of illness, once established, could not stem the tide What was the source of it all? One true physician, Johann Peter Frank (1745–1821), Professor of Medicine at Pavia in Austrian Italy, was determined to find out At the age of forty he had arrived at the ancient University, already in its fifth century of service, just before a visit by the Emperor and despot, Joseph II, was to take place Frank conducted the Emperor on a meticulous tour of the medical establishment, having the ruler's orders noted down, and acted upon, almost as they passed through the wards and laboratories This was a great help, and saved a lot of paper, deliberation and bother First, Frank doubled the lectures, abolished the free Thursdays which the students had had, set up new depart ments including a pathological museum for teaching, and increased the professors' salaries The last item ensured the rapid acceptance of the former The place prospered

In 1786, after being Professor of Medicine for only a year, Frank added to his duties that of Director General of Public

Health in Austrian Italy In this capacity he visited the furthest corners of his territory, talking with every conceivable type of person This was no guided tour The more he saw the more he realized that mere public health measures were not enough The poverty of the people was the fundamental problem to be hurdled

The French Revolution was hardly a year old before Frank, on being asked to give the address to the graduating class of 1790, chose, not the usual clinical subject but an economic one The Emperor had just died after dropping many of his social reforms under pressure of a frightened gentry If France could have a revolution, was there not the same danger in all of Europe? Nevertheless, the courageous Frank stood up and delivered his classic paper, 'The People's Misery—Mother of Disease," thirteen pages of thoughtful analysis of the problem as seen by a physician Let us hear briefly from Frank himself *

> "It is not a fairy tale that virtue has deserted the courts and has chosen to take abode in the peasants' huts But the divine simplicity that took leave from the sumptuous palaces of the ambitious is rarely cultivated under roofs where dire hunger has taken refuge and where despera tion houses When a man's only tie with the society in which he must live is his appeal to compassion—so many times refused—then, in despair, under the influence of the involuntary convulsions of poverty he easily disrupts the very thin thread that hardly connects him any more with the fellow citizens he hates Solicitous about nothing but his own survival, he curses laws which for him alone have *no provisions* Although he *too is a son of the common* Father of all men, yet he is estranged from the world and struggles in any way he can in secret or openly, to reclaim *his part of the natural heritage he lost In one, malice* produces violence In another, misery has blunted any feeling of kindliness, and ignorance and stupidity make him the fiercer Thus virtue, the most solid and only pillar of pub

* Translation by Professor Henry Sigerist

lic security, breaks down and every kind of vice insinuates itself into society threatening destruction, a fatal omen for the state Warning examples are already seen in various countries of Europe After all the land has been divided among the powerful and rich, there is hardly any difference left between the common people and the very beasts of burden except that the beasts precede and pull the plow, while men guide and follow When the people live in such a slavish condition and are excluded from any property right of citizens, shall we perhaps expect them to be more attached to the country than domestic animals which, as they see, are hardly less esteemed? Shall we expect them to raise their emaciated arms with equal power in defense of a hearth that holds no fire for them? Shall we expect them to be eager to procreate children and thus still augment the impossibility of their own subsistence? To bring up children when the only warmth they can give them is that of their love? To save them when they are dangerously ill for the still greater miseries of life, equal to those of their parents? Shall we expect them to teach their sons assiduously to respect laws which deprive their fathers of their natural citizens' rights? To teach them respect of the law as a virtue when it bids them to accept patiently from others nothing but insults, blame, the slavery of starvation and finally even death?"

In a hopeful vein he continued

"Wherever the farmers are permitted some property and some possession of goods, where some reward compensates for the labors and helps to support the growing family, there you will find the people's health flourishing no less than the land they cultivate Everybody must admit from his own experience that the human machine must break down in a very short time if food of the right kind and quantity does not replace what labor has used up every day and sweats have consumed *Slave people are cachectic people* Starvation and sickness are pictures on the face of the entire laboring class You recognize it at first sight And whoever has seen it will certainly not call

any one of these people a free man The word has become meaningless"

Unlike some graduation speakers, Frank remembered the students, and concluded

> "And now I call on you, young men, on thee, Aloisio Mazzoni, thee, Pietro Bandiera, thee, Giacomo Trovati, *that on this happy day you may receive in the presence* of all from my hands the insignia of the highest honor as a reward for your conduct and diligence! Step forward, my friends! Adorn your learned head with the *Laurel of Apollo* and try to deserve the Civic Crown! One without the other soon withers and fades Put the *Rings* on your fingers and, as the bridegroom through this symbol promises faithfulness, help and protection to his beloved wife, so you recognize yourself pledged to help and assistance to the class of the poor which everywhere is the most numerous Finally, I *open* the *book*, to entreat you not to abandon learned endeavors after you have left the University I *close* it when nature teaches you differently, trust nature more than books! And now let me who loves you take you for the last time in my arms What sons owe to their fathers, you owe to me who has assumed this title and has for years taken your father's place Give me this consolation Be useful to the state! Be happy"

Across the English Channel a storm of another sort was brewing The method of "electing" Parliament had fallen into a sad state, when one thinks of Simon de Montfort and his struggle to establish representative government almost six hundred years before, or of the barons presenting the Magna Carta to King John One is scandalized by the situation whereby Cornwall, which is today, even as then, a very sparsely settled county—though its inhabitants like the Davys, the Oslers, and the Singers make up for it in quality—had forty-four seats in Parliament Only forty five seats were allotted to the whole of Scotland with 3,000,000 population The growing cities of Manchester, Liverpool, Sheffield

and Leeds had not a single voice at Westminster Worst of all, the forty-four seats from Cornwall were controlled by 453 human beings. It was a disgrace

It was on this stage that a quiet little general practitioner, James Parkinson (1755–1824), of Shoreditch, London, entered, waving not a sword, but a pen, whose pungency and wit rivalled that of Tom Paine, his contemporary This son of an apothecary surgeon, a church trustee and pioneer in establishing Sunday Schools, was later to give us the greatest medical classic of the early nineteenth century, *An Essay on the Shaking Palsy*, or Parkinsonism, as we now call it But long before writing this, plus several books on chemistry, geology and pediatrics, James Parkinson had become the scourge of what seems to have been the most corrupt Privy Council ever to run the affairs of England, presided over by William Pitt no less

Parkinson, at the age of twenty-three, had already tried his wings with an attack on quackery aimed at a popular local lecturer, a doctor, whose ideas of the circulation of the blood were antique, to be sure Parkinson became so engrossed in proving error that he learned that he must learn more, and next we find him attending the lectures of the great John Hunter in London These, which he took down in shorthand, make a most interesting document. Presumably the elder Parkinson, an apothecary surgeon looked after the very large medical practice while the son James took such excellent post-apprenticeship training At Hunter's lectures he met many men who later distinguished themselves as physicians and, to quote Virchow's phrase, as "the natural attorneys of the poor."

Dining clubs were as popular then as they are today in England They met in pubs with wonderful names descriptive of birds, bulls, dogs and ships The club of Parkinson's choice was the London Corresponding Society, certainly an innocuous name, but, as we shall see, a bulwark in the struggle for constitutional reform Richard Brinsley Sheridan and

Samuel Whitbread, the brewer's son, were prominent in the Whig party, and they blistered the Tories who insisted that they ran the greatest democracy in the world. Certainly, it was the most fraudulently operated.

Alarm went through the ruling circles of Europe when, in September 1792, the French monarchy fell. Immediately repressive measures were taken in England to quiet all those seeking reform of Parliament. The billsticker of the London Corresponding Society was arrested as he went about his job and was thrown in jail. Sir Samson Wright protested vociferously, without avail. The smooth-tongued Edmund Burke went over to the Tories and published his book *Reflections on the Revolution in France.* This ex-reformer would have been the toast of committees of inquisitors today. Burke thundered of the danger that, "Learning will be cast into the mire and trodden down under the hoofs of a swinish multitude" as he warned against his former colleagues in the reform associations. To this Parkinson replied with a six-penny pamphlet, *An Address to the Honorable Edmund Burke from the Swinish Multitude,* under the pseudonym "Old Hubert."

As Parkinson's talented and conscientious biographer, Dr. William McMenemey, the distinguished Oxford and London clinical pathologist, has written, "Now Old Hubert was none other than the quiet, hardworking practitioner of Hoxton Square, James Parkinson. In his practice he had already seen enough of poverty and human distress to know that reform was needed, not only in Parliament but in social affairs." A repeat performance soon brought the avid readers, *Pearls Cast Before Swine by Edmund Burke—Scraped Together by Old Hubert.* In this, Parkinson wrote the prophetic phrase, "When bad men combine, the good must associate; else they will fall, one by one, an unpitied sacrifice in a contemptible struggle."

The first part of Tom Paine's *Rights of Man* had already been published, and now Paine went after the "vile apostate" Burke in earnest. He published the second part of his great

work and fled to France Burke, the turncoat, was now telling the nobility that it was "pure buffoonery to try to reform Parliament" Old Hubert's next broadside was entitled *The Budget of the People* The barometer was obviously rising He wrote, 'If the Princes of Germany continue another century to traffic in human flesh, will not the trade cease for want of commodities?" Old Hubert was well informed He challenged the British Government, in still another pamphlet, to show why they needed 25 million pounds annually, when the whole Federal Government of America needed only 130,000 pounds Then another blast, in *Masts and Acorns* in which he quotes Milton's phrase, "Who knows not that one great Hog may do as much mischief in a garden as many little swine?"

Upon the execution of Louis XVI, the French Ambassador was dismissed from English shores War was declared Petitions to Parliament circulated but were disregarded The presidents of a number of dining clubs met in Edinburgh where they were arrested and "transported" to Australia for fourteen years! William Pitt defended these harsh sentences thus, "This whole system of insurrection would appear, from the papers found with them, to be laid in the modern doctrine of the rights of man—that monstrous doctrine" Lady Anne Hamilton rebuked him

> "We would rather have been Claudius or Caligula than the man who, in cold blood, could deliberately sign a warrant against these patriotic martyrs whose only crime consisted in having supported Mr Pitt's original system of reform"

Nevertheless, these men were put on a waiting ship called 'Surprise Transport" and sent to Australia, as many Canadians were to be sent by Lord Durham forty years later, merely because they sought in Canada the rights of English men in England

With habeas corpus suspended, it took some courage to

say, let alone print, anything in England But Old Hubert was not to be cowed His life was spent with needy people, and they supported him, because he never attacked the Crown His next pamphlet reached the Privy Council level however It was entitled *Revolution Without Bloodshed, or Reformation Preferable to Revolt*" * In addition, Parkinson kept up his financial contributions to the families of men locked up in prison for their views on reform Finally, he was hailed before the Privy Council, where the Attorney General began condescendingly, "Mr Parkinson, you have been at great pains to show " The little doctor quickly cleared up anyone's doubts as he interrupted, 'I have taken pains to say nothing but the truth" When Pitt, in that vermiform manner reserved to committees investigating fellow citizens, asked Parkinson a question, the answer to which might incriminate people about whom Parkinson could not know, our hero rebuked the Prime Minister sharply and gained the support of the Attorney General on rules of evidence He told Pitt to his face, "I wish not to behave with incivility towards your lordships but I must say I am used exceedingly ill ' Pitt was furious and shouted, 'What can you mean, sir, by whom?' Parkinson, looking straight at him, retorted, "By this Board" That ended the questioning As he left this encounter with the supposed servants of the people, Parkinson, poor man, was begged by a patient waiting outside to go to the authorities to try to extract from the Army her idiot son who had just been pressed into service in a Regiment

Parkinson's next triumph came in Old Bailey court, where he and Henry Cline, the surgeon from St Thomas' Hospital, gave evidence on behalf of one of their former colleagues who had studied with them under John Hunter A few more pamphlets lampooning the cost of maintaining a notorious Prince of Wales—something over 100,000 pounds per year, and Parkinson's political career was finished His

* See Appendix to chapter

three volumes *Organic Remains of a Former World* brought him into close touch with Sir Humphry Davy and others in the newly formed Geological Society His book on gout, another on dangerous sports, and his report on a fatal case of perforation of the appendix, the first in English, all preceded his classic on *The Shaking Palsy* (1817) In this little volume of sixty six pages his clinical descriptions were superb He ended by asking pathologists to do all in their power to elucidate the causes of the disease * He represents Britons at their best,—modest, talented, vigilant in the cause of free speech, with far ranging interests, but with no time for the stupid or cupid in public life

By the year 1848 Europe was in another turmoil and the Communist Manifesto of Marx and Engels was abroad in the land A Pomeranian shop keeper's son, Rudolf Virchow, had graduated from the Army Medical Academy in Berlin, had served his year as assistant prosector in pathology, and was now making an investigation for the Government of an outbreak of typhus in Upper Silesia What the Government received was no mere pathological report! Virchow covered the whole history and economic background of his unhappy area and he called for social as well as health reforms there

He had already sounded an alarm in pathological circles, when, in the first volume of his *Archiv,* he said

> "The role of pathological anatomy as a dogmatic science is at an end Pathological physiology will then gradually develop itself, not as the mental product of individual enthusiasm but as the result attained by many investigators from the outcome of laborious research Pathological physiology will then be recognized as the stronghold of scientific medicine to which pathological anatomy and clinical observation form but the outworks"

Whenever I read this I think of Howard Florey remonstrating with Sir Charles Sherrington who wished him to take

* By their benevolent labours its real nature may be ascertained and appropriate modes of relief or even of cure pointed out"

a travelling fellowship in pathology to study in the United States Florey pleaded that he had no credentials in the field, being only a physiologist Sir Charles patted him on the shoulder and told him that was precisely what was needed, an abnormal physiologist, the only true pathologist

The people of Berlin elected Virchow to the National Assembly but he was ruled too young to take his seat! Despite this early reverse he sat in the Reichstag for most of his life, and was the greatest annoyance that ever confronted Bismarck Virchow was dismissed from the Charité Hospital in Berlin for his report His fame as a pathologist brought him immediate election to the Chair of Pathology in Wurzburg He spent seven happy and industrious years there, in which his work on tuberculosis, typhoid, cholera and amyloid degeneration was done He had left behind him in Berlin the short lived journal called *Medical Reform*, its final issue containing a reference to the reigning family of Prussia which had endeared him to many Berliners He had written concerning hereditary disease, "I know a family—a very exalted one—in which the grandfather had softening of the brain, the son hardening of the brain, and the grandson no brain at all" He returned jubilantly to Berlin in 1856 as Professor and in charge of a new institute There he began the hard systematic work on his book *Cellular Pathology* which in two years changed the whole future of medicine Seven years after its publication we find Virchow, the statesman, bringing down the German government on its bill to construct a German navy Bismarck, enraged, challenged him to a duel, for which Virchow was much too busy This irrepressible doctor presided over the key committee of the German Diet, the Finance Committee, for twenty five years Possibly that is how he found so much money for reforms in the field of health, the drainage of Berlin, and for all those things he suggested when a young pioneer in social medicine in Upper Silesia He stands as an example of well trained physicians of this era who sought to prevent ill health by

doing something basic for the potential victims of disease.

Participation in the political life of one's country is not necessarily risking contamination, as seems to be feared obsessively in North America, where, as a result of this myth, crooks find the field magically cleared of most obstacles. In the early days of the United States, doctors took their social duty seriously and five members of the profession signed the Declaration of Independence. Clemenceau served his country well, in the First World War. Sun Yat Sen, another physician, and a pupil of Sir Patrick Manson, who saved him from death after being kidnapped in London, produced the most extensive revolution in history. His life in Hong Kong, Hawaii and in London was truly fantastic. More recently, the distinguished Professor of Physiology in Madrid, Dr. Juan Negrin, supported by such world famous medical scientists as Pio del Rio Hortega, led the legal government of Spain after it was attacked by the Luftwaffe and the Italian Air Force in 1936. He was frozen out by the elected governments of the world through a most unfortunate device, the Committee of Non-Intervention, set up in London to placate Hitler and Mussolini, and eventually to cost the free world dearly.

American and Canadian surgeons of high reputation, such as Dr. Norman Bethune of McGill University, joined Negrin, and took the first modern blood transfusion service to Madrid. Bethune died later in China while performing the same service. His memory is green in that country today. However, the Professor of Medicine at McGill was truly startled recently to be met in the corridors of the Royal Victoria Hospital by the entire touring company of the Peking Opera which had come, unheralded, to put on a performance in memory of the former staff surgeon, Norman Bethune!

When we come to consider the crusading role of physicians in preventing illness, we are dealing with something which the all too voluble critics of the medical profession

cannot fathom—the prevention of something which normally provides a physician his living. To take one specific example: the eradication of scurvy by the drinking of lemon juice. What was the size of the problem? It was just this: On November 4, 1740, Lord Anson set off on a Navy cruise lasting almost four years. In that time he lost four-fifths of his crew, and as a result limped home with only one of the six ships with which he had set sail. Fourteen years later, Dr. James Lind wrote his *Treatise on the Scurvy*, in which he proved, with the help of well-controlled human experiments, that citrus fruits would prevent or cure scurvy. Twenty-two years later, the great and noble Captain Cook was awarded the Copley Medal of the Royal Society of London for proving this all over again. Finally, in 1796, another physician, Dr. Gilbert Blane, as Chief Officer of the Navy Medical Board, succeeded in introducing his lemon juice reform by regulation. Thus, it was forty-three years from Lind's experiment to the Royal Navy's official adoption of anti-scurvy measures. But this is not all. One would have thought that in an armed service, where there is never a shortage of people to record things, someone would have played the part of historian, and would have told of the successful use by Jacques Cartier in 1536 of the needles of evergreen trees near the present site of McGill University in Montreal, to relieve the scurvy which had struck down 100 of the 110 men in his expedition. Also, in 1593, Sir Richard Hawkins wrote in his *Observations on the Voyage to the South Sea* that he had seen 10,000 men die of scurvy in his twenty years at sea, and that oranges and lemons could both prevent and cure scurvy. The late lamented Vilhjalmur Stefansson (1879–1962) has analysed the fate of several expeditions in terms of scurvy, ranging from that of Sir Hugh Willoughby in 1553 to Lapland, to that of Barents to Novaya Zemlya, of the Dane, Jens Munk to what is now Churchill, Manitoba, in 1619, and of Robert Falcon Scott and of Ernest Henry Shackleton to the Antarctic. In perusing this fantastic

cavalcade of human misery, of each expedition not knowing or not really understanding the cause of their failure, one is reminded of the Greek saying of the fifth century, B C, "Not to know what happened in the world before you were born is to remain forever a child And yet people continue to ask Of what use is medical history?"

There is no more glorious story in the history of the medical profession than that of Oliver Wendell Holmes—the poet, and Ignatz Semmelweis—the peasant, as they struggled to free women from the curse of child bed fever It is so familiar that it need not be repeated in any detail here What is not well known, however, is the apprenticeship which each served in law school before entering medicine, and the student interest which each had in the spread of infection It is scarcely credible that two pamphleteering physicians, one in Boston and the other in Budapest, could rid the world, through their pens, of more deaths than all the swords of history could claim Finally, Semmelweis, worn out and unhinged, died in a mental hospital Holmes lived a long and useful life, and transmitted to his son ideas on the subject of criminal responsibility before the law which even today affect the statutes of every modern country

Holmes broadside was fired by a man who, in his student days in Paris hospitals with Louis and Andral, had been nursing the idea that puerperal fever *could* be contagious Now, in 1843, he felt, after listening to his more truthful colleagues, that it *must* be contagious Holmes found in the meagre literature available on this subject *A Treatise on the Epidemic Puerperal Fever* written by Alexander Gordon of Aberdeen forty eight years previously It embodied his observations of just nine years of practice in which he directed the Aberdeen dispensary which had been founded for the purpose of attending in their own houses such patients as could not be admitted into the infirmary " Here the former Naval surgeon studied meticulously the 12 925 patients who came under his care

As Holmes puts it, Gordon's 'expressions are so clear, his experience is given with such manly distinctness and disinterested honesty, that it may be quoted as a model which might have been often followed with advantage" Perhaps Holmes was referring to the paragraph in which Gordon said

> "By observation I plainly perceived the channel by which it (puerperal sepsis) was propagated and I arrived at that certainty in the matter, that I could venture to foretell what women would be affected with the dis ease, upon hearing by what midwife they were to be de livered, or by what nurse they were to be attended during their lying in, and in almost every instance my prediction was verified"

He added

> It is a disagreeable declaration for me to mention, that I myself was the means of carrying the infection to a great number of women"

The reception of Gordon's little publication reminds one of the hard fate of William Harvey who, it is said, on announcing his discovery of the movement of the blood in a circle, lost half his practice Gordon wrote of the reception of his well founded ideas

> "The benevolent reader must observe, with displeasure, the ungenerous treatment which I met with from that very sex whose sufferings I was at so much pains to re lieve, for, while I was using my best endeavors to mitigate the calamities of many miserable sufferers, several others were very busy traducing my character"

It is easy to imagine with what relief Gordon was called up again by the Navy, in whose service he died at the age of forty seven years, of pulmonary tuberculosis

One of the factors most frequently overlooked in recounting the history of medical discoveries is that of their social context Sometimes lay society can be seen to have cut the

physician contributor to pieces with sharp tongues. In the case of Oliver Wendell Holmes, the self-regardant "leaders" of the profession talked nonsense to their students and to the public, while claiming loudly that they were being slandered by malcontents. This obscurantism is still fashionable, it is alleged, today. Holmes' chief adversary, Professor Charles Meigs of Philadelphia, was able, in the midst of suffering and death, to write in his textbook on obstetrics that a woman's mind fitted her only for home duties "except when, like the star of day, she deigns to issue forth to exhibit her beauty and her grace." She had "a head almost too small for intellect but just big enough for love." The wonder of it is not so much that Holmes should have anything to fear from such an adversary, but, rather, that Meigs should ever have reached the top of the ladder in Philadelphia. Gordon of Aberdeen summed it up well when he said, "Scientific practice and popular opinion very seldom correspond."

We must pause for a moment to salute the pioneers of social medicine who gave the world the science of statistics. These men, with soft hearts and hard heads, have shown from an intelligent examination of data accumulated over the years, what results follow from what methods of *not* looking after the health of nations. We think of Bisset Hawkins, whose *Elements of Medical Statistics* is the first book in this field by an English physician, of Sir William Petty, who rose from a cabin boy's station in life to be one of England's wealthiest and most intelligent men. With John Graunt, he provided the basis for our tables of mortality and life expectancy. Thomas Short, a Scottish graduate in medicine, using the crude figures at hand, and by comparing the ratio of burials to baptisms arrived at a ratio of the health of a community. Thomas Percival, a first class medical scientist, proved that the smoky cities of the industrial revolution had an infant mortality many times that of their rural neighbours. Percival fought all his life against the employment without restriction of children of five and six years of age in industry

John Ferriar fought against "corruption" or infection which, he warned the burghers, was to be visited upon rich and poor alike. Southwood Smith was an excellent practitioner near the Tower Bridge and spent his life in blasting the sunless, airless abodes which were the lot of the poor of London. William Farr, translator of Virgil, advisor to Florence Nightingale, and the conscience of British public health, was the most accomplished of the group of physician statisticians. With John Snow, the anaesthetist, he proved the connection between polluted water and cholera. He was a pioneer in the calculation of literacy and educational standards from parish registers, where bridegrooms usually wrote their names, and brides marked an "x." To complete this group of great public servants we have Sir John Simon, pathologist, researcher on the thyroid and thymus, and Fellow of the Royal Society at the age of twenty-nine. This great man, as Medical Officer to the Privy Council, built up a group of superlative scientific workers about him, including Thudichum, the German refugee who became the father of neurochemistry. He left Britain the richer for his presence.

There is not space to detail, even in the most superficial way, the advances in the present century which have changed the way the world lives and moves about. Certainly the antibiotics, the immunization against poliomyelitis, have been dramatic developments in the past two decades. While infections still rob the world of much of its joy, nutritional problems are today probably more serious, if only because of their economic aspects. In the past century science has in*vaded the skull, and the stigma attached to nervous and men*tal diseases is receding, though slowly. All the more remarkable, therefore, is the progress which neurological surgeons like Harvey Cushing and Wilder Penfield have made in relieving the uncontrolled epileptic of his burden, through operations on the brain. When one sees the diagnostic triumphs of neuropsychiatrists like Denis Hill at the Maudsley Hospital, aided in the field of cerebral surgery by Murray Fal-

coner, one comes to believe that the future beckons us hopefully in this unhappy, expensive and too long sterile field of human conduct Thirty years ago the clear sighted Penfield was one of the few voices urging young scientists to look for the cause of the major diseases afflicting the mind, in the test tube Today, chemists the world over are beginning to move rapidly in the exploration of normal and abnormal brain function They wonder, at times, why less than one per cent of the cost of mental illness is spent on research into its causes It is to be hoped that the fog which has shrouded this field will soon be dissipated by the sun of public approbation and real support for research

We come finally to a large and thorny problem in any consideration of medical contributors to social progress, i e , the future form of the provision of medical care to all people, everywhere This is a tall order, and it cannot be resolved on the pages of one book nor of a thousand books Certainly medical history has a great deal to contribute, especially on the background reasons which gave certain systems of medical care their present characteristics of form and function With the holders of extremist positions shrieking at each other across a no man's-land scorched by fear, it would be a foolish person indeed who would put his head up even to measure the wind velocity, let alone suggest the outline of a remedy And yet, as this chapter demonstrates, medical men in the past have given social leadership at critical periods in history If they will do their own thinking today, instead of decerebrating a great profession through the use of "public relations men'—the plague of our time, they will preserve intact the high reputation inherited from the contributors we have discussed in this chapter

Appendix

'Taxes might be proportioned to the abilities of those on whom they are levied, and not made to fall heavier on the poor than the rich

"The present system of Excising almost all the necessities of life, as soap, candles, starch, beer etc might be abolished

"The Poor Laws and laws of Settlement might be amended and a poor man not be liable to be sent to prison for moving out of his own parish to seek employment

"The Game Laws might be abolished, and the farmer be no longer obliged to permit his rich and insolvent neighbours to trample his fields in pursuit of an animal which, though fed by the produce of his own grounds, the farmer himself dares not kill, but under the penalty of fines and imprisonment

"Workmen might no longer be punished with imprisonment for uniting to obtain an increase of wages, whilst their masters are allowed to conspire against them with impunity

"Some proportion might be preserved between Crime and Punishment, and the starving purloiner of a few shillings not suffer the same punishment as a murderer

"The clergy might be provided for by an income more regularly proportioned, and levied in a more agreeable and respectable mode A part of the vast revenues of the Bishops might relieve our numerous starving clergy

"The rich might be prevented from swelling their excessive incomes by monopolising the necessaries of life and even the farms by which they are produced

"Some National Establishment might yield to the children of the Poor such instruction as might enable them to earn their living, and form a just notion of their rights and duties as members of society

"Constant employ might be secured to the industrious and due provision be made for the aged and disabled

"The unfortunate tradesmen, ruined perhaps by some swindler of rank, might not be consigned to the horrors of a dungeon, because oppressed by the heavy load of misfortune

"Our sailors might not be dragged like felons into a service they dislike, and made accomplices in slaughter

"Difference of opinion in religious matters might not ex-

clude men from enjoying the same benefits with their fellow citizens.

"Expenses of the nation might not then exceed as they do now the enormous sum of £80,000 per day, £300 per hour and £50 per minute."

from *Revolution Without Bloodshed, or Reformation Preferable to Revolt*
by James Parkinson (1755–1824)

Chapter III

Ramón y Cajal, Charles Sherrington, Ross Harrison and the Neurone Theory

There is no system of organs in which proper function is so dependent on the minute arrangements of cellular elements as in the nervous system and none that approaches it in the complexity of this arrangement.

Ross G. Harrison

When we think of that great country Spain, with its history a mixture of beauty and tragedy, we think, perhaps, of three great explorers which it has produced: Columbus, who explored the infinitely large; El Greco, who explored and painted the infinitely beautiful; and Ramón y Cajal, who explored the infinitely small,—the microscopic structures of the nervous system. Born in 1852 in an isolated corner of the Pyrenees in an equally isolated country, far removed from the stirrings of the nineteenth century in the rest of the world, Santiago Ramón y Cajal was the least likely of all Spaniards to become a scientist, a writer of international repute, and winner of the Nobel Prize in Medicine. It is incredible that this recalcitrant lad, born into the family of a barber-surgeon living in a small mountain village, should one day give up the juvenile delinquency for which he was noted, his baiting of the police, his shifting from job to job as a ne'er-do-well, frustrated by an overly strict father who had no use for his son's wishes to draw and paint, and that he might one day settle down, and as a medical student draw a great atlas of anatomy which, alas, could not be printed be-

cause of the cost, in Spain Once a kindly shoemaker started to restore the boy's disintegrating self confidence, and once a friendly confectioner had given him to read *The Voyages of Captain Cook* and *Robinson Crusoe,* the enquiring mind of Ramón y Cajal started to change the whole story of medicine as related to the nervous system He graduated from medicine without ever having seen a microscope or a microscopic preparation He laboured hard to perfect himself as an anatomist He served his time in the corrupt and inefficient Spanish army in Spain and in Cuba only to be brought home with malaria, and, as it later transpired, tuberculosis

It was while convalescing from tuberculosis in the Pyrenees that Cajal became interested in the chemistry of the photographic process, and became extremely skilful in the making of special silver compounds with which to coat collodion plates Although he failed at first to win a Professorship of Anatomy or Histology, he kept working in his home medical school of Zaragossa, and used the last of his Cuban savings from military days to buy a Verick microscope which he had seen on a brief visit to Madrid He began to publish his work in a paper in the mountains called *The Catholic Daily* and he sent one hundred reprints of his first publication, which was on inflammation in the mesentery, cornea and cartilage, to professors and crowned heads in European countries Thus, in the year 1880, we find Ramón y Cajal telling the world, or a limited part of it, about the phagocytic properties of blood cells His colleagues, locally, said, 'Who is this Cajal to criticise foreign workers?'

A second paper followed on nerve endings in muscle It was here that he began the first use of ammoniated silver in staining Here, too, began the process which we use every day now, that of gold toning to reinforce silver stains His rustic colleagues thought that the microscope was not to be trusted and that it was actually some invention of the devil At about the same time another student discoverer in the microscopic field, William Osler, was trying to smuggle

a microscope into McGill University in Montreal, the better to teach his students in 'The Institutes of Medicine," or the microscopic anatomy section of this course With the small income derived from service at a smallpox hospital, Osler purchased a microscope which he was allowed to set up only on Saturday afternoons in the professor's cloakroom when no one was about, and there to demonstrate the wonders of the microscopic world to his Canadian students It is interesting that Osler's first book was a manual of histology for his students Similarly, Cajal's first book, when he became a professor at Valencia, was a little text on microscopic anatomy for the local students

In 1885 a cholera epidemic swept Spain and, though stationed in Valencia, Cajal gave a great deal of assistance to his native people in Zaragossa At the end of the epidemic the people of that city presented Cajal with a beautiful Zeiss microscope, the equal of anything to be found in Paris or Berlin This aided him greatly in his work and he expanded his book on histology to include microscopic techniques, so that it contained 203 illustrations and 692 pages in all A second edition was needed in 1893 so popular did it become

Cajal's early and halting paper on the nerve supply to muscle must have hit home in one place, at least, for soon the benevolent and ever-helpful Professor Krause of Gottingen invited Cajal to contribute two papers to his *International Monthly for Anatomy and Physiology* Krause did more, far more He sent valuable bibliographic references, journals and even books as gifts to encourage this pioneer worker from the Pyrenees In addition to his two papers which soon appeared in Germany, on epithelium and on muscles in insects, Cajal published locally several papers on the structure of the crystalline lens, on the staining of bony tissue, and on mammalian muscle fibres

During a visit to Madrid he chanced upon a small and unofficial institute for biological research which had been set up by a number of enthusiastic physicians who had returned

recently from Paris Among them was Dr Luis Simarro, a psychiatrist, who was seeking in the structure of the brain some explanation of the mental illnesses of his patients In this work he had employed a silver chromate stain which had recently been developed in Italy by Camillo Golgi Golgi, as an undergraduate at Pavia in 1865 had written a thesis in which he stated that there was a need for a classification of menal diseases according to microscopic structural changes which could be demonstrated in the brain The French and German reviews had given short shrift to Golgi's staining method, but Simarro had stayed with it until he had produced some beautiful preparations of the human nervous system Thus it was that in 1887 the imagination of Cajal was fired by what he saw under Simarro's microscope in Madrid Cajal wrote then

> "Against a clear background stood black threadlets, some slender and smooth, some thick and thorny, in a pattern punctuated by small dense spots, stellate or fusi form All was sharp as a sketch with Chinese ink on trans parent Japan paper And to think that that was the same tissue which, when stained with carmine or logwood, left the eye in a tangled thicket where sight may stare and grope forever fruitlessly, baffled in its efforts to unravel confusion, and lost forever in a twilit doubt. Here on the contrary, all was clear and plain as a diagram A look was enough Dumbfounded I could not take my eye from the microscope"

Simarro had actually given up this staining method as being too capricious and he therefore gave to Cajal his copy of Golgi's paper which the young professor now read and reread in Valencia Cajal worked like a man possessed and in the ensuing weeks made hundreds of sections of various tissues in which he was able to see and confirm everything which Golgi had reported

Just at this time Cajal was made Professor of Histology at Barcelona and he feverishly prepared a small laboratory in

his house there in order to get on with what he regarded as a sensational development, for him at least, in his study He had worked through all the tissues of the body methodically except the nervous system, and now was his great time of testing

Cajal s first discoveries in the microscopic structure of the nervous system were revealed to the anatomical world on May 1, 1888, in his new journal, the *Revista Trimestral de Histología Normal y Patológica* To understand the full impact of his work let us go back in history to pick up some important threads and to see the setting and properties of the stage upon which Cajal was to be the chief actor for the next fifty years

Sherrington has expressed it well with his great sense of the dramatic He wrote

> "The microscopy of the nervous system had, by the latter half of last century, grown into something of a special study It relied on its own votaries, not many, but distributed world wide Fellowship in their somewhat recon dite pursuit united them quasisocially into a sort of fam ily, a family not shrewdly discontent with its own achievement nor indeed gravely perturbed by a slowness of progress which seemed to challenge eternity Upon this pedestrian tradition, when the century entered its final decade, burst suddenly an astonishing Spanish master

The background is interesting Just fifty five years pre viously Ehrenberg had discovered and characterized nerve cells The medical student Helmholtz working in the laboratory of that great educator Johannes Muller, proved what we would now consider a very elementary truth, that nerve cells were actually connected with peripheral nerves, or better stated, that nerve fibres were merely peripheral extensions of nerve cells

While Helmholtz was demonstrating this in the ganglia of leeches and crabs, another medical student in Muller's lab-

oratory, Robert Remak, was demonstrating the same thing in vertebrates, and publishing it in his graduation thesis of forty two pages, which was to attract the favourable notice of Alexander von Humboldt, the naturalist and explorer

Sigmund Freud, as a medical student, was one of the fore runners of what we now call the neurone theory, as was William James of Harvard In the year 1884 Gad made an interesting generalization which brought us a little closer to the truth when he said that dendrites exist for the sole purpose of leading nervous impulses towards the axon and never from it Golgi in 1885 stated that dendrites ended freely in the grey matter but he did not attribute to them any role in the conduction of the nerve impulse A year later the distinguished histologist and embryologist His stated that he believed the processes of nerve cells ended freely in the gray matter He was soon joined in this view by August Forel, and some would read, even in Forel's paper of 1877, a clear enunciation of the neurone theory

Professor Liddell at Oxford has recently called attention to Sharpey Schafer's forgotten observation on the little jelly fish *Aurelia* which he found in the Moray Firth in Scotland during an expedition there, also in 1877 It is hard to understand how his wonderful description failed to evoke any responsive chord in Europe at the time To quote Professor Liddell on Sharpey Schafer's discovery

> Before his time it was supposed that the nerves round the edge of the umbrella were a continuous net with fibres joining end to end in a continuum for the conveyance of impulses round the umbrella But Sharpey Schafer showed clearly in a paper published in the following year in the *Philosophical Transactions* (1878) that the nerve cells and their processes were separate, lying side by side intermingled, intertwining, though without continuity or end to end joining of their terminal fibres His pictures show all that quite clearly He speculated on the conveyance of nerve messages from one of these cells to another, and

thought that there must be 'inductive action, whether electrical or of some other kind'"

Against these pioneers stood highly respected workers such as Gerlach, Meynert, and actually also Golgi, who believed that, for all practical purposes, the nervous system was *one great anastomotic network of nerve fibres* It seems utterly fantastic to us today to think that such men, who must have been in touch with their clinical colleagues at some point in their lives, could talk so naively about a system which has to rely on purposeful conduction if man's will is to be carried out at all In fact these latter workers had two alternate explanations, neither of which made any sense One might say, in their view, that the nervous system conducted diffusely in all directions, or, alternately, that the nerve cells existed in some marvellous way merely to feed and nourish the nerve fibres Possibly this reticularist school was caught up in the ancient analogy in which the nerves, like the arteries, ramified into finer and finer subdivisions, all connected by minute bridges Some histological stains showed nets, truly enough, but they were connective tissue stains and not those specific for the nervous system

Using the only specific nervous system stain in which he had faith, i e, Golgi's silver chromate stain, Cajal drove himself to the limit, and with his paper *on the structure of* the nervous system of birds in 1888, gave us four generalizations which have stood up for more than seventy years to some of the most vitriolic onslaughts in the history of medical writing These laws were (a) the axons of nerve cells and their collateral branches end by free aborizations, and *not by a diffuse network*, (b) *these arborizations or terminals* are applied to the surface of the next cell body and its dendrites (I will have occasion to refer later to the extension of this particular observation in our own studies of the cerebral cortex of humans), (c) therefore, both the cell bodies and their dendrites play a similar role in nervous conduc-

tion, (d) the nervous impulse is transmitted by contact, or possibly by induction. These remarkable generalizations stemmed directly from the beautiful Golgi preparations which Cajal made of the bird's retina, olfactory bulb, brain, cord, medulla and ganglia. The anatomical detail which he saw in his sections enabled him to correlate the structures seen with the obvious direction of flow of *sensory* impulses, especially in the olfactory and retinal neurones.

It is little wonder therefore that the Anatomical Society of Berlin, though Professor Kolliker, invited Cajal to lecture on his recent work. Kolliker had only two years previously visited Golgi in Italy and had seen his remarkable preparations and, with Golgi, still clung to the "reticular theory" of an all inclusive fibrous network within the nervous system. Now, on seeing Cajal's preparations in Berlin, *under the microscope*, Kolliker gave up Golgi's theory entirely, and became a disciple of Cajal to such a degree that he even learned Spanish in order to read all his papers. Once Kolliker was convinced, most mature histologists in Europe came to agree with Cajal's views. As Professor Pi-Suñer has said, "Cajal's conversion of Kolliker in Berlin in 1899 is reminiscent of that by another Barcelona professor, Gimbernat, who converted the famous surgeon John Hunter to his way of thinking." Wherever he went Cajal inspired histologists with a new view and a new sense of urgency in the study of the microscopic structure of the nervous system. He visited his friend and benefactor Professor Krause at Gottingen, who had first published his work in the outside world, even paying for Cajal's illustrations himself. Cajal also visited Weigert whose staining methods he had seen in Simarro's laboratory in Madrid at the time of the great Golgi stain revelation to him there. Before leaving Germany, Cajal also saw Edinger and Paul Ehrlich. Possibly it was from Ehrlich that Cajal obtained the supply of methylene blue which remained for many years at the Instituto Cajal in Madrid. It was a small amount of this unexcelled staining substance which the In-

stitute gave to Howard Florey as a parting gift after his studies in Madrid in 1934

Cajal told his audiences, "There await in the bosom of the living being, millions of palpitating cells which, for the surrender of their secret and with it the halo of fame, demand only a clear and persistent intelligence to contemplate, admire and understand them"

Upon his return from Germany Cajal began to develop what he called "the law of the dynamic polarization of the neurone" His briefest statement of it is the following

> "The nerve cell body and dendrites possess an axipetal conduction, that is, they lead impulses toward the axone of the cell On the other hand the axone possesses somatofugal or dendrifugal powers of conduction, and it thus sends the impulses from the soma and dendrites down to the axone's terminal aborizations'

In his wonderful publication *La Cellule*, van Gehuchten of Louvain, in the April 1891 issue, commented on some of Cajal's generalizations, but felt that they were based on too many unproven assumptions Cajal says that it was while thinking about this criticism, and writing a much fuller statement of his neurone theory in reply to it, that the full impact of "dynamic polarization of the neurone" appeared to him With the generosity typical of the Spanish people he then launched his neurone theory as a joint creation of van Gehuchten and himself

A word must be said here concerning the term "the neurone theory" It is carelessly attributed to the German anatomist and publicist Waldeyer This is unjust In his wonderful book of memoirs translated by Horne Craigie of Toronto, Cajal has said, "That which, and all that, Waldeyer did, was to publish in a weekly newspaper a resume of my research and to invent the word neurone" As Sir Charles Sherrington has said, "Not at any time had the researches of Waldeyer touched the subject He had not contributed ei-

ther to the discoveries or to the generalizations The whole circumstance made Cajal feel more fully, and somewhat bitterly, the impotence of his country's language as the medium for holding, let alone catching, the scientific ear, even of those cosmopolitan words which cultivate medicine and science" I can vouch for the fact that Sherrington knew in great detail whereof he spoke, for he had learned Spanish in the same cholera epidemic of 1885 in Spain through which Cajal had worked so tirelessly, and remembered it to the end of his very long life In addition, Sherrington knew Waldeyer during his own apprenticeship served in Berlin Waldeyer had pointed out a nerve cell under the microscope to Sir Charles and called it "Das Denkorgan" An equally superficial view would seem to be evident in Waldeyer's being given credit for any part in the development of the neurone theory

Within a few months Cajal was transferred to Madrid as Professor of Histology and was soon invited by The Royal Society of London to give its Croonian Lecture for 1894 Cajal was the guest of Professor and Mrs Sherrington and introduced the Continental habit of airing the bedclothes from the windows and rooftops every morning to thunderstruck and conservative Londoners Moreover, Cajal set up a little silver staining laboratory which he concealed under the bed in his room and covered the floor with endless microscopic slides which he wished the English scientists to view

Sherrington grew uneasy as these treasures began piling up, for he realized that the large audience likely to be drawn to a Croonian Lecture at the Royal Society's classical rooms in Burlington House, was not likely to queue up after the lecture to look down microscopes for an hour! Therefore, Sherrington absconded with two nice preparations of the cerebellum and had lantern slides made of them But, explain as he might, Sherrington could not get Cajal to consent to the showing of these slides Sir Charles gave them to me when I left Oxford in 1938, laughingly suggesting that per-

haps I could find a way to show them, because he had never been able to!

Cajal's visit to London opened his eyes in a number of directions. Here was a peasant from the Pyrenees seeing for the first time the movement of more than a million people into the City of London in the morning and out again in the evening. He asked Sherrington to take him to the bridges across the Thames River, every morning early, so that he might continue to watch this spectacle. It was hard for Cajal to get his bearings, however, and he predicted an early end to England's power and prosperity because he had seen no factories whatever in coming up from the Channel by the boat-train! Sherrington assured him on this point by telling him that England already had far too many factories but they were not located on the route of the boat train from the South Coast. They went up to Cambridge where Don Santiago received an honorary degree, having almost missed the ceremony by lingering too long in the beautiful college gardens admiring the flowers.

Cajal's return to Madrid, after receiving such honours at the hands of the Royal Society in London, was something of a triumphal entry. He was Spain's first F.R.S. in over 150 years. Universities and governments now sought to support his work and to build him an institute, to name him a life Senator, to put his portrait on bank notes and postage stamps, but he refused to permit this. He also declined the post of Minister of Public Instruction in the Spanish Cabinet, very wisely as events later proved.

He proceeded to wring the greatest possible amount of information out of the embryo and adult nervous system with Golgi's stains. However, it worried him as an histologist, that he could not get better definition of nerve fibres and intracellular structures with that stain. He was thinking about this on a train returning from a holiday in Italy in 1903 when, like a flash, an idea struck him. He remembered his early days of primitive but inventive photography in the

Pyrenees as he was recuperating from tuberculosis He saw in an instant the possibilities of impregnating nervous tissue with silver nitrate and then of using a photographic reducer such as hydroquinone to bring up a black and white or black and gold picture under the microscope with much finer detail than was hitherto possible Once back in Madrid he put all his energies into this new technique which he perfected as the "reduced silver nitrate technique", he continued to exploit it until the end of his life in 1934 No more valuable staining technique has ever been developed

The new reduced silver nitrate technique made possible great advances in two fields first, inside the cell where the neurofibrils could now be studied without the hindrance of an overlying network of non nervous tissue such as had been stained for a generation by Bethe and Apathy, and, secondly, the whole new world of the interconnections between nerve cells, the "end feet" of Held, or the "boutons terminaux" as the French named them, and as we usually designate them today

As will be clearly recognized, we are now approaching the very core of the controversy over "continuity versus contact" at these junction points, which was to rage for more than another generation In order to get crisp, clear staining of these axonal terminations, Cajal forsook adult tissues and used only embryonic material Cajal began to realize that the embryological development of the nervous system was on his side in the controversy and he came to regard the terminal arborizations as merely the end stations of developing neurones, as they make contact with the next neurone in the nervous circuit. He wrote picturesquely

> "What mysterious forces precede the appearance of the nerve processes promote their growth and ramifications, stimulate the corresponding migration of the cells and fibres in predetermined directions, as if in obedience to a skilfully arranged architectural plan, and finally establish those protoplasmic kisses, the intercellular articulations,

which seem to constitute the final ecstacy of an epic love story?"

Meanwhile, the physiologists had gone out ahead, and on the basis of Cajal's early Golgi preparations and his clear statement of the dynamic polarization of the neurone, they postulated an irreversible junction point where an axone applied terminal buttons to the dendrite and soma of the next nerve cell to be stimulated As early as 1897 Sherrington had introduced the great concept of the "synapse," implying both anatomical and physiological discontinuity In a personal communication to John Fulton in 1936, Sherrington wrote

> 'Foster had asked me to get on with the Nervous System part (part III) of a new edition of his *Textbook of Physiology* for him I had begun it and had not got far with it before I felt the need of some name to call the junction between nerve cell and nerve cell (because the place of junction now entered physiology as carrying functional importance) I wrote him of my difficulty and my wish to introduce a specific name I suggested using 'syndesm' He consulted his Trinity friend Verrall, the Euripidean scholar, about it, and Verrall suggested 'synapse' (from the Greek 'clasp') and as that yields a better adjectival form it was adopted for the book"

In the summer of 1904 Yale University was the scene of the next great statement of these underlying principles as Charles Sherrington, Professor of Physiology at the University of Liverpool, gave his Silliman Lectures in New Haven entitled "The integrative action of the nervous system" Sherrington, the early pathologist and histologist, now turned physiologist, gave one of the most remarkable series of lectures which has ever been read in any university It is truly a landmark in our understanding of the laws of the nervous system In his first lecture Sherrington, if we may quote him briefly, outlined the three great characteristics of nerve cells He said

> "In the first place nerve cells like all other cells, lead individual lives,—they breathe, they assimilate, they dispense *their own stores of energy*, they repair their own substantial waste, each is, in short, a living unit, with its nutrition more or less centred in itself Secondly, *nervous cells present features so characteristically* developed in them as to be specially theirs They have in exceptional measure the power to spatially transmit (or conduct) *states of excitement* (or nerve impulses) generated within them But a third aspect which nervous reactions offer to the physiologist is the *integrative* In the *multicellular animal, especially for those higher reactions* which constitute its behaviour as a social unit in the natural economy, it is nervous reaction which *par excellence integrates it, welds it together from its components, and* constitutes it, from a mere collection of organs, an animal individual"

Sherrington proceeded to state in detail the anatomical facts whose relevance we have just been reviewing

> "The grey matter is the field of nexus between neurone and neurone Except in sympathetic ganglia, the place of nexus between neurone and neurone lies nowhere else than in grey matter We know of no reflex arc composed of one single neurone only In other words, every reflex arc must contain a nexus between one neurone and another The reflex arc must therefore, on the cell theory, be expected to include not only intracellular conduction, but intercellular conduction If there exists any surface or separation at the nexus between neurone and neurone, much of what is characteristic of the conduction exhibited by the reflex arc might be more easily explicable"

He then prophetically added

> "Even should a membrane visible to the microscope not appear, the mere fact of non confluence of *the one with* the other implies the existence of a surface separation Such a surface might restrain diffusion, bank up osmotic pressure, restrict *the movement of ions, accumulate elec-*

> tric charges, support a double electric layer, alter in shape and surface tension with changes in difference of potential, alter in difference of potential with changes in surface tension or in shape, or intervene as a membrane between dilute solutions of electrolyte or different concentration of colloidal suspensions with different signs of charge It would be a mechanism where nervous conduction, especially predominantly physical in nature, might have grafted upon it, characters just such as those differentiating reflex-arc conduction from nerve trunk conduction"

Sherrington focussed attention on such physiological properties as irreversibility of conduction across the synapse, temporal and spatial summation at the synapse, all requiring just such structures as Ramón y Cajal had demonstrated in his histological studies on the synapse Degeneration of nerves peripheral to a transection of their trunk, first described by Augustus Waller, provided a very strong argument in support of the neurone theory It is little wonder that in 1906 Cajal began his great work on degeneration and regeneration within the nervous system He was able to show clearly that degeneration of axonal terminals proceeded only as far as the synaptic membrane and never influenced structurally the next nerve cell in the circuit Regenerating fibres eventually restored synaptic contact with the deprived cell by ring-like axonal terminals, as shown later in the sympathetic nervous system by De Castro and Gibson

While histology, pathology and physiology were coming to the support of the neurone theory, one of America's most original minds was finishing up his postgraduate studies at the University of Bonn in Germany I refer, of course, to Ross Granville Harrison (1870–1959), a graduate of Johns Hopkins University, who set out to elucidate embryological development in the nervous system He did this against a background of three important developmental theories which can be quickly summarized He knew his history well, and his papers and his discoveries show it. The first theory

was the "cell chain theory" which Schwann in 1839 enunciated, one year after his great generalization, "the cell theory." Schwann thought that the nerve fibres were formed by the same chain of cells that gave rise to the neurilemmal or Schwann sheath. The second theory was the "outgrowth theory" which was put forward, in rudimentary form, by Bidder and Kupfer in 1857, but was much more firmly established by His (1886–1890) and by Ramon y Cajal (1890). This stated that the nerve fibre was an outgrowth of a single cell or neuroblast. Finally, the third was the "plasmoderm" theory of Hensen (1864). He believed that nerve fibres were produced *in situ* by differentiation of a pre formed set of protoplasmic bridges, once nerve function began.

Writing of his 1904 researches Harrison said:

> "The decision between neuroblast and sheath cells was reached by removing the source of each element in turn, and finding that neurones with naked axis cylinders developed when the ganglion crest, the source of the sheath cells, was removed and the neuroblasts were left intact, while no nerve fibres developed at all when only sheath cells remained."

Harrison continued:

> "The nerve cells send out protoplasmic processes which gradually expand to nerve fibres. . . . The ends of these developing nerve fibres consist of a thickening with finely branched *pseudopodia*."

These are precisely the structures which later make contact with other nerve cells. Ross Harrison saw the whole problem as revolving around a special application of the general proposition, the cell theory.

To answer the protoplasmic bridges problem posed by the third theory mentioned above, Harrison, in 1907, working at Yale University made one of the greatest advances in the study of living matter, in all time. He states it quite simply, "The next and final step was to remove the embryonic nervous tissue from the organ entirely by means of the explanta

tion experiment, the method now known as tissue culture" There is no need here to expand on the great value of the tissue culture technique and of the great benefits to mankind which have flowed from its use, most recently in the field of poliomyelitis immunization Suffice it to say that it was the product of a well trained and inventive mind

Harrison concluded as a result of his study of embryonic nervous tissue removed entirely from the body, and cultured in a drop of lymph on a special microscopic slide, that, "The substance of the axone originates in the neuroblast and is spun out by means of the amoeboid activity of the end, without material contribution from the surrounding proto plasmic bridges, which may serve however as a framework to support and guide the fibres The outgrowth of the nerve fibre is, therefore, a mode of protoplasmic movement and not a progressive differentiation *in situ*"

Cajal regarded the work of Ross Harrison as giving the neurone theory some of the most powerful support it had received He turned to tissue culture work in Spain and passed it on eventually to his great pupil Pio del Rió Hortega at the Cancer Institute in Madrid where I saw it in use in 1936

As he proceeded further with studies on degeneration in the nervous system Cajal laid the foundation, of course, for a great many modern neuro anatomical studies which stain, with silver, degenerating fibre tracts which have been interrupted experimentally in order that they may be traced to their eventual termination on the dendrite or cell body next in the circuit The reactivation of this method of tracing bouton terminal degeneration in Sherrington's laboratory at Oxford by E C Hoff set off a chain reaction which is still going For more than twenty years I have been immersed in this subject, applying Rio Hortega's beautiful double impregnation technique to the spinal cord, sympathetic nervous system, cerebellum and finally to human brains in which frontal lobotomy or other tract cutting operations have taken place

The list of active workers in this field would run into sev-

eral dozens today, which precludes mention of them individually here The most recent work on the numbers of boutons terminaux to be found on the surface of large anterior horn cells in the spinal cord deserves special notice We find a very beautiful reconstruction on a three dimensional basis by Murray Barr of the University of Western Ontario, of the bouton endings on anterior horn cells We have also the *remarkable work of Professor J Z* Young of University College, London, who with his group has pioneered a post-chroming type of staining which suggests that nerve cells probably have not too few, but probably too many, bouton terminals on their surface for us to count!

Many long-closed doors await the fashioning of new keys or techniques in staining, for their opening I do not propose to deal with electron microscopy of the synapse, for this is a *world in itself I must mention, however, a recent publication* which appeared in *Science* by my friend Dr Ernest Retzlaff, working at Ohio State University Medical Center His illustrations show the difference in silver staining of nerve cells after they have been stimulated by *excitatory* contacts as distinct from *inhibitory* boutons terminaux Again, a new horizon is opening in the combined study of the microanatomy and the microphysiology of the nervous system *As a neurohistologist I must say that we have a great deal of ground to* cover before we catch up to our neurophysiological confreres Better techniques to be used in the preparation of specimens for both the light microscope and the electron microscope are urgently needed if we are to serve students of the nervous system better For, as Jean Fernel said so long ago, "Anatomy is to physiology what geography is to history, it describes the theatre of events" In retrospect, the three giants in this field, whom we have discussed here, remain after more than fifty years, the undisputed fathers of basic neurology

Chapter IV

Pioneers of Aviation Medicine

I have been largely influenced by the ideas and work of older physiologists If, however, I have gone backward, it is only to pick up clues which have been temporarily lost, and all of these clues lead forward—forward to a new physiology which embodies what was really implicit in the old

JOHN SCOTT HALDANE (1920)

TO SOME it may seem strange that a subject as new as aviation could have a specialty of medicine attached to it, much less a history The fact is, however, that medical men and medical problems have been closely associated from the first with human flight

The story begins in the year 1782 with the brothers Montgolfier living near Lyons in France, starting in on aeronautics from first principles They had been reading Joseph Priestley's treatises on the properties of air, and found that, in the kitchen of their home, they were able to propel paper bags up to the ceiling by heating the air within them As long as the source of heat was suspended on a metal tray beneath the bag, there seemed to be no limit to the ascent Accordingly, these sons of a paper manufacturer made a balloon of linen and paper from a number of sections, buttoned together, and on June 5, 1783 they set a little fire made of straw and wool under it, with the result that the balloon rose from the market place on their town of Annonay Soon Paris was agog with the

news, and the physicist Charles was instructed by the Academy of Science to investigate the matter.

The brothers now proceeded to Paris for the next logical step, that of sending aloft some passengers. These, in the shape of a sheep, a duck and a chicken, ascended and descended safely on September 19th of the same year, again using the hot air principle. Two months later, on 21 November, after experiments using humans in a tethered balloon, the surgeon, Pilatre de Rozier, of Metz, and the Marquis d'Arlandes, ascended in a hot air balloon. The King, Louis XVI, had wished to send up two criminals first, but was dissuaded by the aeronauts who sought the chance. The balloon travelled five miles in twenty-five minutes. Benjamin Franklin was present at the launching, and was asked, it is said, what use was a balloon? He countered with the well-known phrase, "What good is a new-born babe?" Dr. Whitfield Bell tells me that Franklin jumped to the conclusion that balloons would ensure world peace, since they could sail over towers and walls of fortresses, rendering them useless!

Meantime, Professor Charles had been busy launching a hydrogen-filled balloon, the gas being entrapped by taffeta covered with a rubber solution.* The Montgolfiers had given up hydrogen because it penetrated their paper balloon. Jenner, in England, was soon filling balloons with hydrogen in the great hall of Berkeley Castle, and releasing them over Gloucestershire, some with poetry attached, asking for their safe return to him. The subspecialty of pediatric aeronautics began in Baltimore in the following year, when on June 24th a thirteen-year old boy, Edward Warren, was airborne for a few moments in a Montgolfier. This same year, 1784, saw two notable ascents in England, the first by Vincent Lunardi, the secretary to the Neopolitan Embassy in London. His passengers included a dog and a cat, the latter hopping out half-

* Professor Charles and his collaborators were at one time arrested on orders from the King, acting on the advice of his ecclesiastical advisors, for endangering human lives!

frozen during a temporary touchdown The wine and food became mixed up with the sand ballast, but otherwise the two hour flight was a tremendous success By the time Michaelmas term was about to begin at Oxford, James Sadler, a confectioner of that delightful city, made his first of many flights in a Montgolfier, and, as an historian of the time records, "received the approbation of the entire University," surely the first and last time that an Oxford tradesman has been thus honoured To Queen's College, Oxford, however, goes the honour of being the first college to put up a balloon, an unmanned hydrogen containing type, about five feet in diameter, on February 19, 1784 Three days later a similar small balloon was released at Sandwich, Kent, and crossed the Channel to land near Lille

While these ascents were going on, the air minded physicians were not idle As soon as the success of the Montgolfiers was announced, the great Swiss mathematician and physician, Leonhard Euler (1707–83), set out to derive the formulae expressing the rate of descent of balloons James Tytler (1747–1805), a Scottish surgeon, ascended to a height of 350 feet, from Comley Gardens in Edinburgh He has been described as

> "A surgeon who failed in practice, an apothecary who was obliged to close his shop, a husband who was deserted by his wife, a Proprietor of a laboratory which did not cover expenses, a debtor who sought the refuge of Holyrood House, an historian whose book was never finished, an editor whose periodicals suspended publication, *a hack who wrote much of the second edition of the Encyclopedia Britannica* (at the rate of seventeen shillings a week)"

In London the physician and chemist George Fordyce had spent a day and a night in filling Lunardi's balloon with hydrogen, made from sulphuric acid ... while 200,000 people waited impatiently Even ... ck, the chemist in Scotland, the discoverer of ... while in medi-

cal school, now took to laboratory ballooning, and we find him trying to make a small aerostat from a calf's bladder filled with hydrogen The French aeronaut Blanchard took Sheldon the British anatomist aloft, while the latter tried out a motor driven propeller, which unfortunately was a failure Next Blanchard ascended with his financial backer, Dr John Jeffries of Boston, who because of political difficulties had graduated in medicine at Aberdeen Jeffries was intent upon measuring the physical properties of the atmosphere at various heights, as suggested by Cavendish Accordingly, he carried on his first flight with Blanchard a Toricelli mercury barometer, and instruments for measuring the temperature, moisture and electric disturbances of the air He took up little bottles filled with water, which were emptied at altitude, for the purpose of bringing back air samples His results are certainly up to modern standards, and he emerges as a serious student among a cloud of merely hopeful travellers

While all this was going on in England, the surgeon aeronaut Pilatre de Rozier was labouring mightily in France to prepare a combined hot air and hydrogen balloon in which to cross the Channel to England In September, 1784 he and Pierre Romain signed an agreement for this purpose and set about building this complicated and dangerous affair at the Tuileries in Paris Their target date was a crossing on January 1, 1785 The Government of France advanced a large sum of money for the construction, and soon we find the pilot embarked on the first of those political face saving adventures in aviation which have cost so many lives since The further the preparations went the worse did the problems become, and Professor Charles warned that a match was being put under a powder keg by introducing a hot air furnace below a hydrogen filled bag De Rozier had the notion that the way to regulate altitude most easily was (a) to put a little more fuel on the fire, or (b) conversely, to damp it with water from a sponge, during flight

The irrepressible Blanchard was unlikely to allow his countryman to precede him across the Channel, so with Dr Jeffries he announced a flight from Dover, for the month of December Though all was ready by that date they had to wait the better part of a month for favourable winds and weather Finally, on January 7, 1785, they cast off from Dover According to some historians the Governor of Dover Castle had to intercede in a quarrel between the two, as Blanchard wished at first to exclude Jeffries from the flight entirely, saying that there was no room in the basket There was room, however, for an odd assortment of flags, anchors, life jackets, brandy, biscuits, apples and pamphlets As the balloon rose Jeffries was moved by the magnificence of the white chalk cliffs of Dover Half way across the Channel, however, he became aware that a serious leak had developed in the balloon, and that only extreme measures would see them safely on the French shore Thus all the ballast and apparatus just listed had to be jettisoned, and Jeffries offered to jump into the sea himself if it would get the balloon across However, an updraft of air caught them in time and deposited them a little distance inland, whereupon began two months of festivities in France!

Sad to relate, it was close to this spot that Pilatre de Rozier and Romain crashed fatally six months later, in attempting their long postponed flight in the opposite direction The Marquis de Maisonfort, the superior officer in Boulogne, had approached Pilatre just before his take off, with a large sum of money, begging to be included as a passenger He even had one foot on board, says one historian, but was turned back because de Rozier said he was not sure enough of the balloon One thing weighed heavily upon de Rozier, the load of personal debt which he had accumulated over the enterprise The Minister in Paris rejected all further bills submitted by him, and his creditors were closing in Some think that he had taken out a passport for England and Holland previously, in order to flee his creditors The fatal ascent took

place one day before he was to appear in the debtors court in *Boulogne* The Marquis de Maisonfort, the rejected passenger, states that no fire took place, and that the wreckage showed no charring He attributes the sudden collapse of the balloon to the precipitate *opening of the hydrogen valve* and the forceful tearing of the deteriorating fabric Thus began the long series of mysterious aeronautical deaths which unfortunately continues today

The idea of mechanical propulsion and guidance in balloon flights had occurred to many We have noted Sheldon's unsuccessful attempts Jeffries and Blanchard used a "moulinet," a forerunner of the propeller, to no avail The German medical graduate and physicist, Christian Gottlieb Kratzenstein, practising in Copenhagen, proposed propellers in his book, *L'Art de Naviguer Dans L'Air*, which he dedicated to Professor Charles Hugh Bell, a London physician, also attempted propellers and steering gear in balloons, without success

The practice of aerial photography seems to have begun with a medical student Felix Tournachon, popularly known as NADAR He was born in 1820, and despite the wildest ballooning career in history lived to the age of ninety! There is no suggestion that he ever finished his medical training, but for an aeronaut he studied at the right medical schools, Lyons and Paris, where ballooning history began In 1858 he took the first aerial photograph of Paris from a height of approximately 1,700 feet Strangely enough, such a development had been forecast in the *science fiction comics* of France for a period of ten years by the cartoonist Maurisset This, too, has a familiar ring to those who were sworn to secrecy in World War II, only to find in the comic strips of the daily newspapers strangely accurate details of the latest or even projected devices

Nadar, in 1863, produced the largest spherical balloon ever made It was 144 feet in diameter and held 262,000 cu-

bic feet of gas A small army of seamstresses was called out to sew together more than 200,000 square feet of taffeta in Paris The 'basket" beneath the great gas chamber was in this instance the size of a two story house Journeys of eight days were contemplated in The Giant, as it was named Twenty four passengers in evening dress took off from Paris in the first flight, dining well and casting the remnants to the earthbound below By the following day they found themselves over Hanover As a low altitude storm approached an argument broke out between the pilot and the proprietors—similar to those which go on today in poorly regulated airlines—with near-fatal results By pulling on the valve cord, passengers caused the monster to deflate The bag, however, served as a potent sail for some time, while deceleration took place—in what we would consider today a model fashion—spread out over thirty minutes, and thus decreasing the impact However, all manner of structures and trees on the ground were demolished in the process and a few fractures were suffered by The Giant's first-and last occupants Thus, we see two further problems in aviation safety thrusting up their heads, (a) conflict between aeronauts and those with a proprietary interest in flying, and (b) safe methods and areas for deceleration

Once it had been demonstrated that there were likely to be upper limits to the *size* of balloons, men soon came forward to defy the limits of *altitude* which Nature had imposed on them The Victorian era was not likely to be impressed by Robert Boyle's warnings of anoxia in his writings on *The Spring of the Air*, two hundred years previously They were certainly not to be put off by the uncanny and detailed reports of travel in South America by Father Joseph de Acosta in the late sixteenth century His account published in 1588 in Salamanca may have reached Oxford ears, because of the long connection between the two centres of learning, but it was not brought home to the Victorians who as a full-

recording instruments The balloon was so badly constructed that as they ascended to 5,200 metres, the envelope herniated down over their heads like the greater omentum, threatening to crush them Barral stabbed the envelope with his knife, and the pair were almost asphyxiated by the hydrogen which billowed out upon them They vomited profusely Within seven minutes they were back on the ground, having slowed their otherwise fatal plunge to earth by throwing overboard everything which they had in the way of ballast and protective clothing In typically French fashion, however, it is recorded that they 'had the honour to preserve their instruments' Their predicament calls to mind the problem of asphyxia in the air from inhaling noxious gases, such as carbon monoxide, sometimes liberated by aircraft heating units, as well as the dangers of inflating flotation gear, such as life jackets, while still at high altitudes

While French aeronauts were chilled by the experience of Bixio and Barral, two hardy British pioneers Glaisher and Coxwell ascended in 1862 to 29,000 feet, as registered on their barometer Glaisher's voyage, financed by the British Association for the Advancement of Science, took place at Wolverhampton At 26,000 feet Glaisher could not see his instruments, became deaf, and was paralysed in all four limbs Coxwell, a most skilled operator, is said to have pulled the valve cord with his teeth, so badly off was he This near fatal episode set the stage for a real tragedy

Three French balloonists, spurred on by Glaisher's altitude record, now prepared to ascend to 8,000 metres! They had had the advice of Paul Bert on certain aspects of the projected ascent, but he was away from Paris when the oxygen requirement was being decided Sivel, Croce Spinelli and Tissandier reckoned that a total of 150 litres of oxygen, in a container, would suffice, since, they said, they would only breathe it when they felt they needed it They mentioned this to Bert in a letter, and he wrote at once, that for such altitudes the three men would require at least 20 litres per min-

ute, and that the projected total of 150 litres was absolutely insufficient His letter arrived after the flight had taken off

The records of the tragic episode show that several miles up, Tissandier could not muster strength enough to get his gloves out of his pocket to protect his freezing hands At 7,450 metres the temperature was 10 degrees below zero Tissandier nevertheless continued to scribble, almost illegibly, and his companions closed their eyes Sivel was roused to cut loose more sandbags, and Tissandier records, "Sivel throws ballast Sivel throws ballast," a good example of anoxic perseveration, and a sad reminder of the loss of judgment which had already taken place

They passed 8,000 metres (as their instruments later showed), and then started to descend Eventually all awoke, and anoxically threw out more ballast, although they had already conquered their goal of 8,000 metres They really did not know what they were about, as they tossed over clothing and even the oxygen aspirator This was a crude moistener, in which the oxygen coming from the storage tanks was bubbled through water flavoured with tincture of benzoin (Evidently the process for manufacturing oxygen had left an unpleasant odour in it) This bubbling aspirator probably allowed no oxygen to get to the men once the water within it froze over The balloon now rose to 8,600 metres, as the barometer tube recorded All were unconscious On arriving on the earth's surface eventually, only Tissandier was alive Most of the oxygen in the tanks remained unused!

As Paul Bert wrote, this tragedy shook France to its very foundations The idea that two men could die, *in the air* was something with a ghostlike tinge to it. Some scientists very wisely suggested pressurized cabins, of the type we have today Paul Bert replied acidly, 'Nothing thus far seriously proposed is worthy of the charming mystification of a Voyage to the Moon, and Jules Verne will pardon me if I do not discuss it' Within three years Bert had produced his great book *La Pression Barometrique* Researchers in World War II

owed a great deal to John Fulton for having had this remarkable classic translated by Dr and Mrs F. A. Hitchcock at Ohio State University

To Boyle and Bert aviation medicine owes its roots To Yale University also, this specialty of medicine and physiology owes a great deal In 1911 a combined Oxford-Yale expedition carried out far-reaching and basic researches on human physiological problems at altitude, on Pike's Peak in Colorado. Strangely, Pike, the soldier-explorer had never been able to climb his own peak! In 1911, however, Douglas and John Scott Haldane of Oxford, and Yandell Henderson with Edward Schneider of Yale, ascended in a cogwheel railway, up a twenty-five per cent grade The publication of their results came just a year before World War I In 1917 Haldane returned to give the Silliman Lectures at Yale, entitled *Organism and Environment as Illustrated by the Physiology of Breathing* Haldane pursued this view further in his classic, entitled *Respiration* which was published by the Yale University Press in 1920

It should be added that the pressurized cabins suggested after the French tragedy of 1875 did not come into common use until 1945 In the interim, pressurized breathing was devised, and I had the honour of working on it with Professor Cuthbert Bazett of the University of Philadelphia when he came to Canada to assist with physiological problems, after the death of Sir Frederick Banting The late Squadron Leader Alex Fraser of McGill's Department of Pharmacology took the apparatus to the European Theatre for us in 1943, and it allowed photo-reconnaisance squadrons to operate at 45,000 feet long before the Invasion began The role of Lovelace and Boothby in designing the American system must also be acknowledged here Post war, the apparatus came to be used, successfully, in clinical cases of pulmonary oedema So much for oxygen

The initiation of powered flight by two bicycle mechanics, the Wright brothers, brought in its wake a new set of medi-

cal problems. Before touching upon these, however, let us recall briefly the association of medical graduates with the early researches on powered aircraft. Dr. James Bell Pettigrew (1834–1908) published an important book in 1873, entitled *Animal Locomotion, on Walking, Swimming and Flying, with a Dissertation on Aeronautics*. He looked upon the wings of birds as segments of a propeller, and he stressed the elasticity of the wing as a means of lateral control. This was to be the secret which the Wright brothers discovered in their early work on gliding, over the sands of Kitty Hawk, North Carolina. To my mind, the Wright brothers provide one of the most interesting and incredible studies in modern times. They wrote in a very matter-of-fact way to the Smithsonian Institution that they had decided to fly, and would like to have various publications, and certain questions answered. Wilbur Wright has written.

> "My own active interest in aeronautical problems dates back to the death of Lilienthal in 1896. The brief notice of his death which appeared in the telegraphic news at the time aroused a passive interest which had existed from my childhood, and led me to take down from the shelves of our home library a book on *Animal Mechanism* by Prof. Marey, which I had already read several times. From this I was led to read more modern works, and, as my brother soon became equally interested with myself, we passed from the reading to the thinking, and finally, to the working stage."

What, then, was Marey's contribution? About 1870, medically trained Etienne Jules Marey (1830–1904) built a small centrifuge, in the form of a rotating circular table, with which to investigate the supporting and lifting power of curved surfaces, such as the wings of birds. In addition, he devised a camera which would take sixty exposures per second on a moving film, and with this he analysed the movement of birds in ascending, in flight, and on descent. He built a flapping model of an insect which worked quite well to show the

principles of powered flight, albeit of limited horsepower Thus, Marey carried out in his laboratory in Paris what Lilienthal carried out in his more than 2,000 flights made with wings which supported his own weight for downhill distances of 400 yards Wright memorialized Lilienthal, who was killed by crashing from a height of sixty feet in such a glide, "Lilienthal not only thought, but acted, and, in so doing, probably made the greatest contribution to the solution of the flying problem that has ever been made by one man

Lilienthal seems to have been the first man who really comprehended that balancing was the *first*, instead of the last, of the problems in connection with human flight"

We must pass quickly to the pioneers of our subject who changed the course of the First World War I think first of Leonard Hill, whose book on Caisson disease and his works on circulation, especially cerebral circulation, are milestones of our art When he stole Martin Flack from his anatomical colleague Sir Arthur Keith at the London Hospital, just before the outbreak of war in 1914, he stole a good man Flack as a medical student had discovered the sino auricular node of the heart, as he cut thousands of histological sections in Keith's kitchen down in the village of Borden, Kent Between games of golf, teacher and pupil worked out the heart's electrical conducting system as we know it today Once attached to the Royal Air Force, Flack set out a series of tests for fitness to fly to which we must return with all speed if we are to save our pilots and passengers a great deal of grief

Edward Schneider of Pike's Peak days, became the physiologist to the American air forces in their army shack laboratory at Mineola on Long Island Here his fitness test was worked out, and was used in the Second World War Here, also Lyster, Wilmer, Jones and Lewis drew up the standards of fitness for aircrew, and directed that a moving picture should be made demonstrating vestibular function in flight This was done in the basement of the Surgeon General's Li-

brary in Washington without any Hollywood fanfare Leonard G Rowntree made a remarkable study in 1918 of the accidents which were plaguing American flyers He showed that for every flyer killed in combat three were killed in training accidents As Louis Bauer put it, 'Not every one could fly" What a tragedy, therefore, that the labours of highly skilled American researchers throughout the years of the First World War should be brought to naught, when, in 1920, Mineola was closed and all the records burned

There is not space to go through the fields of decompression sickness, motion sickness, acceleration and blackout, night vision and air ambulances Yet, the historical approach is the only one which yields results applicable to future practice The German Air Force learned much from its experience with air ambulances in the so called Spanish Civil War, flying the German soldiers injured in the fighting, from Madrid to Berlin nonstop, using adequate oxygen They were years ahead of us in building a human centrifuge, and in helicopters

One wonders, 'Is aviation medicine dead? Did it cease to exist with the end of the Second World War?" The answer is a definite "No" If we were to apply, to cases of air embolism in our hospitals, the lessons of denitrogenation learned in Canadian and American laboratories during the war we would save more lives If we used long established physiological techniques to exclude from aircrew both fainters and epileptics, we would have fewer fatal crashes If we studied the cerebral circulation in all pilots over the age of 50 years, and the means are at hand in every good hospital today, we would solve some of the physiological problems which bedevil governments today Details of human physiology in space travel are now household words around a very small world We have moved some distance from the days of 1919 when a U S War Department publication complained, "Wonderful has been the development of the airplane, inconceivable has been the neglect of the man in the airplane"

This story therefore, will have been worth recounting if only to recall the intensity of the effort which has been poured into human physiological research in the service of aviation for almost two centuries, and which can serve us still, if we will but allow it.

Chapter V

Pioneers in Localization of Function in the Brain

There are few stories whose general appeal, to lay and medical men alike, rivals that of the geography of the human brain and its exploration For many years I have been in the habit of reading to my students in courses on cerebral localization a passage from Nicolas Stensen's *Dissertation on the Anatomy of the Brain*, read at M Thevenot's house in Paris in the year 1665 The translation is that of my friend Professor E Busch of Copenhagen

"Gentlemen,

Instead of promising that I shall satisfy your curiosity in what relates to the Anatomy of the Brain, I begin by publickly and frankly owning that I know nothing of the matter I wish I were the only Person under the necessity of talking in this manner, because I might in time become acquainted with what others know, and it would be a great blessing to Mankind if this most delicate Part, and which is liable to so many dangerous Diseases, were as well understood as the generality of Anatomists and Philosophers imagine it to be In this, few imitate the Sincerity of Sylvius who never talks positively concerning the Brain, though he has been at more pains about it than any man that I know The number of those who think everything easy is infinitely the greatest, and they give us the History of the Brain and Disposition of its Parts with the same confidence and assurance, as if they had been present at the Formation of this surprising Machine, and had been let into all the Designs of the Great Architect Though the number of these positive Gentlemen be very

great, and though I cannot pretend to answer for the Sentiments of all the rest, I am nevertheless very much convinced that they who search for solid Knowledge will find nothing satisfactory in all that has been written about the Brain It is very certain that it is the principal Organ of the Soul and the Instrument by which it works very wonderful Effects The Soul which imagines it can penetrate into everything without it, and that nothing in the World can set bounds to its Knowledge, is nevertheless utterly at a loss to describe its own Habitation, and is nowhere more to seek than at home We need only view a Dissection of that large Mass, the Brain, to have ground to bewail our Ignorance On the very Surface you see varieties which deserve your admiration, but when you would look into its inner Substance you are utterly in the dark, being able to say nothing more that there are two Substances one greyish the other white, which last is continuous with the Nerves distributed all over the body, that the greyish Substance serves in some places for a Cortex to the White, and that in other places it separates the white Filaments from each other

"If we are asked what these Substances are, in what manner the Nerves are joined in the white Substance or how far their Extremities penetrate into it, all we can do is to own our ignorance, except we be resolved to increase the number of those who prefer the applause of the publick to sincerity and truth For, to say that the white Substance is only an uniform Body like Wax without any Art concealed in it, would be to think too meanly of this great Masterpiece of Nature We are sure that wherever there are Fibres in the Body, they always observe a certain regular order more or less complex in proportion to the Functions for which they are appointed If this Substance is everywhere Fibrous, as it appears in many places to be, you must own that these Fibres are disposed in the most artful manner, since all the diversity of our Sensations and Motions depends upon them We admire the contrivance of the Fibres of every Muscle, and ought still more to admire their disposition in the Brain, where an infinite num-

> ber of them contained in a very small Space, do each execute their particular Offices without confusion or disorder"

However, the *Edwin Smith Surgical Papyrus*, written about 1600 B C, from still more ancient material, opens the door on the earliest recorded localization of function with descriptions of injuries to the brain While the text is possibly fragmentary by present day standards of description, it is nevertheless terse and to the point, or, as we might imagine, written in the telegraphic style of busy surgeons today Case No 20 is a good example

> "If thou examinest a man having a wound in his temple penetrating to the bone (and) perforating his temporal bone, while his two eyes are blood shot, he discharges blood from his nostrils, and a little drops, if thou puttest thy fingers on the mouth of that wound (and) he shudder exceedingly, if thou ask of him concerning his malady and he speak not to thee while copious tears fall from both his eyes, so that he thrusts his hand often to his face that he may wipe both his eyes with the back of his hand as a child does, and knows not that he does so (this is) an ailment not to be treated"

The Egyptian surgeon of old repeated, in his diagnostic statement, the point concerning speechlessness, and then proceeded to detail the treatment thus, "Now when thou findest that man speechless his (relief) shall be sitting, soften his head with grease (and) pour milk into both his ears" The "relief" offered in this context would suggest that the case was so hopeless that only superficial treatment and observation could be offered the victim It should be noted that the expression to "shudder exceedingly" appears six times in the Papyrus One wonders if it denotes motor activity from cortical irritation induced by probing or examination of an open wound of the skull

Coming to Roman times we find the physician Scribonius

Largus holding electric torpedo fish to the heads of patients and causing them to discharge their thirty volts, rendering the person stupefied for an interval No focal stimulation was noted in these treatments, nor in repetitions by Galen, nor by Pliny the Elder (Book 32X) who used such discharges to ease labour pains! A change in consciousness and a centrally produced reduction in pain were the only results

The seventeenth century provides some remarkable clues to cerebral localization which, it would seem from the literature two hundred years later, have been largely forgotten For instance, the Honorable Robert Boyle, in his *Experimenta et Observationes Physicae* of 1691, relates the following

'The I Pentade Experiment 1

A very Tall and well Set Gentleman, Aged about 24 years, by a Fall from his Horse, had his Skull broken in several places, and being a Person of good Estate, had several Chirurgeons to attend him in the course of his Sickness, during which he was divers times Trepan'd, and had several pieces of his Skull taken off, which left great Chasms (that I have seen and felt) between the remaining Parts Within about three days after his Fall, this Knight (for so he now is) was taken with a Dead Palsey on his Right Side, which did not equally affect his Arm and his Leg The use of the latter being somtimes suddenly Restor'd to him in some measure and (tho seldom) after a while almost as suddenly Lost But his Arm and Head were constantly Paralytical, being wholly depriv'd of Motion, and having so little Sense, that it would sometimes lye under his Body without his Feeling it But if his Hand were prick't with a Pin, he could take notice of it This Palsey continu'd during almost the whole time of the Cure which lasted 23 or 24 Weeks And when the Chirurgeons were going to close up his Head, as having no more to do, one of them who was an Ingenious Man, and Tenant to this Gentleman, oppos'd all the rest, alledging, that, if they did no more, the Gentleman would lead an Useless

and very Melancholy Life, and that he was confident, the Palsey was some way or other occasion'd by the Fall, which had left somthing in the Head that they had not yet discover'd And the Knight himself agreeing to this Man's motion, his Head was further laid open, and at length, under a piece of proud Flesh, they found, with much ado, a Splinter, or rather Flake, of a Bone, that bore hard upon the *dura mater*, and was not pull'd out without a great Hemorrhage, and such a stretch of the Parts, as made the Patient think his Brain it self was tearing out. But this Mischief was soon Remedy'd, and his Hurts securely Heal'd up, and he is now a Strong Healthy Man, and finds no Inconvenience by having so broad and various a *Callus instead of the Skull, save that he is little* obnoxious to take Cold in his Head But the memorable Circumstances, for whose sake I mention this Narrative, were these When I ask'd him how big the Bone was, that was last taken out? He told me that it was less than half the Nail of one of his Fingers (not his Thumb) and that it was almost as thin, being in size and shape like the Scale of a Fish. But that it did not in his Head lye flat, but bore hard upon the *dura mater* When I ask'd him how long after it *was taken out, he began to feel some* Relief, *as to his* Paralytic Distemper? He reply'd, That in less than five hours he found himself, to his great joy, able to move *his little* Finger, and (tho this happen'd in the Evening) he was the next morning able to move all his Fingers, and within 2 or 3 days after to lift up his Arm By which it seem'd manifest, that so little a Body as the Splinter lately mention'd, produc'd in so robust a Person, a Palsey of the whole side it lay on For when I particularly ask't him, Whether, after the taking away of the proud Flesh that encompass'd the little Bone, he did not find, if he found none before, some Relief *as to his* Palsey? He answer'd, that he found none at all, till the Bone had been pull'd out, which was not till a good while after the *Chirurgeon had been by degrees* eating off the proud Flesh that grew about it But there was in this case another *phaenomenon* that *I thought little less* considerable than the former For, remembring the impor-

tant controversie, that is agitated among modern Physicians and Anatomists, about Nutrition by the Nerves, and having thereupon ask'd this Knight, whether he did not find an Atrophy in the Limbs of his Body that were affected? He told me, that when he began to be Paralytic on that side, it by degrees much wasted, and the Paralytic Leg was very much Extenuated But the Arm and Hand much more, seeming nothing but a System of Bones, with the Skin pasted on them And when I further ask'd, if upon the removal of the Bony Splinter above mentioned, the Atrophy of the Parts did not also begin to lessen, he answered affirmatively, and told me, that in no very long time his Leg and Arm recover'd their wonted Dimensions, and in effect I (some days since) saw the restor'd Arm well plump'd up with musculous Flesh, tho the Weather were exceeding Cold And he further told me, that he found no difference between the Limbs that had been Paralytic, and the others, except that they would grow sooner and more sensibly cold in Sharp or Frosty Weather

'This Gentleman answer'd me, to add that upon the by, that, during the course of his Cure, he was very frequently (almost every second day) let Blood, that he wanted not Appetite to his Meat, that for the most part he slept indifferent well, and, which was more remarkable, upon so great a Hurt of the Head he did not Vomit, nor had afterwards any Convulsions"

The great clinical observer Hermann Boerhaave (1668–1738) has described an even more bizarre case, of great interest in the study of localization of function to specific areas of the brain He relates that a beggar was seen in Paris, begging money with his calvarium, which, having been removed from the rest of his skull, was now held in his outstretched and demanding hand How this skull-cap had been removed is not specified, but the beggar was a one man physiological laboratory for all to see For a few coins he would allow his benefactor to press over the occipital area of the bony defect,

and as one's thumb pressed upon the brain, which was covered only with dura and an overlay of skin or fibrous tissue, the beggar would describe the sparks and flashes of light which he experienced. He had several arrangements into which a donor might enter, but the most spectacular was that in which, after paying a rather large amount, the student of physiology might press on the brain so massively and forcibly that the beggar would drop unconscious to the ground. Except to a few surgeons, such as the talented Edward Archibald, the predecessor of Wilder Penfield at McGill, this remarkable case seems to have remained unknown.

In the Boerhaave tradition in Britain was William Heberden. His posthumous works, published in 1802, give some very clear statements of aphasia. His contemporary in France, Theophile de Bordeu (1722–1776), believed that every organ of the body had representation in the brain. He is often cited as a forerunner also in the field of endocrinology, for he taught that each organ added some specific principle to the blood stream. His greatest claim to fame, however, may be that he was the teacher of the great Phillip Pinel who did so much for humane psychiatry.

In Sweden a surgeon named Acrel removed the first tumor involving the brain in 1776 just four years after the death of the cerebral localizer and theologian Emanuel Swedenborg. In Parma, Italy, in the same year, a young medical student, Francesco Gennari, was dissecting an artifically frozen cadaver when he discovered the broad white line which separates the layers of grey matter in the occipital cortex in man's brain. His life and works have been detailed in a remarkable paper with the original illustrations by John Fulton in 1937. Gennari wrote:

> "This line I first saw the 2nd February 1776 and having often followed it, it seemed to run finally to the ultimate *substance of the hippocampus*. For the rest I am ignorant to what purpose that substance may be formed, like so

> many others of which the use is still hidden, at any rate some of those who combat by the animal spirits, may perhaps draw such an argument for their existence, which in every time, even the hour in which I write, is much disputed I exhort the anatomists in every way to enquire into this substance '

This acute observer, aged twenty-three, also noted the formation of small icicles in the ventricles of the brain and wherever the cerebrospinal fluid passed He deduced that this fluid, during life, must have a cushioning effect on the brain inside the skull

Five years later, Gennari's white line was seen quite independently by that versatile neuroanatomist Vicq d'Azyr Seven years after this work, Samuel Thomas von Soemmering described the line also This was not, of course, his only claim to fame His student thesis of 1778 had already made history, for it established a new method of numbering the cranial nerves, and his method we use today The former method of Willis was, thereafter, discarded Soemmering is credited with many notable advances in physics, such as the camera lucida, and he was the forerunner of the inventor of the electric telegraph He knew how to concentrate the alcoholic fraction in wine, and he was a paleontologist He admired British teachers such as John Hunter and Monro Secundus, with whom he studied, and was a Jenner disciple He was concerned to show the origin, as he imagined it, of the cranial nerves from the walls of the ventricles He believed the cerebrospinal fluid in some way charged with the transport of sensation, with the result that he thought of nerves as conveying fluid impulses to the periphery In 1796 he sent a copy of his book on the cerebral cavities entitled *On the Organ of the Soul* to his friend Goethe, the poet, who quickly advised him that his book would be better called *On the Cerebral Endings of the Nerves,* leaving the Soul' to look after itself Goethe knew something of aphasia, having described the case of his maternal grandfather, in *William Meister's*

Apprenticeship, according to Walther Riese Pinel and even Johann Peter Frank, the great pioneer in preventive medi cine, also described clinical cases of aphasia

In 1788 we find Hunter's brother in law, Everard Home, with the assistance of Philip Syng Physick, trephining a sheep for "the staggers," and finding a hydatid in the brain Then came the deluge, in the person of Franz Josef Gall (1758–1828), the author of the system or pseudo science known as "phrenology" He had excellent anatomical training at Vienna, and learned clinical observation with no less a figure than van Swieten, Boerhaave's disciple At the age of thirty eight, Gall began to lecture in Vienna on the configuration of the bony skull as interpreter of the underlying brain, and as related to mental and emotional characteristics of an individual Palpation of the skull by Gall is reminiscent of the laying on of hands by Mesmer, the founder of the school of animal magnetism, another highly popular pseudo-scientific diversion of the suggestible

Gall, whom Percival Bailey claims was both suggestible and paranoid as a student, saw meaning in the great frontal bossing of the skull of one of his competitors at school, pos sessed of a formidable memory He added other fantastic ob servations until he had thirty seven different mental "facul ties' represented on the surface of the brain These faculties were "amativeness," 'cautiousness" and so on The latter faculty was not very well developed in Gall, who soon found himself opposed by the philosophers who were angered by his parcelation of the brain's surface They denounced him as a "materialist" A century later William James was to speak of neuro anatomists and physiologists as constructing "a psychology without a soul," and, of course, today we find history repeating itself as neurophysiologists studying the living human brain, are dismissed as meddlers by their "couch colleagues," sometimes referred to in Britain as "the odd treating the id" While the aimless controversy over phrenology, based on too few facts and too many theories,

gained momentum, a first class observation was made by the surgeon Francois Parfour de Petit He was called to see an officer who had developed a right sided supra orbital brain abscess as a result of a penetrating rapier wound of the skull His paralysis was limited to the left side of the body

Such clinical truths, however, were drowned in the onrush of speculation One is reminded of the salty phrases of Olof Rudbeck, one of the discoverers of the lymphatics, when he wrote

> "However primitive was the natural philosophy of the time, yet there were few who would depart from it With a word it resolved many difficulties without blacken ing the hands with charcoal in chemistry neither did one get backache from enquiring into the nature of earths, metals and minerals nor did the stomach become weak from dissecting nor the eyes from staying awake nights to observe the peculiarities of the stars but in a warm house by fictitious words and distinctions men became learned, and he was held most learned who could think in the most subtle manner"

It was into this anatomical vacuum that Pierre Fluorens was drawn, when, in 1823, he took up his ablation work on the brain of birds This crudely performed type of experi-mental work soon became the touchstone for a group of ad mirers whose knowledge of birds' brains was second only to their relish for Fluorens oratory, for he was a polished ex-positor As Gerhardt von Bonin points out in his unparalleled volume *Some Papers on the Cerebral Cortex,* Fluorens was careful always to use the term 'cerebral lobes,' rather than 'cortex,' which was as well, since birds have little or no cere bral cortex Fluorens and his disciples hastily generalized from the bird brain to the human brain, holding that there was no motor function resident in the cerebral cortex Thus, we find the skull palpating Gall on one wicket and the bird brain ablater Fluorens on the other, while, forgotten in a corner, because they were busy alleviating human suffering

were the clinicians, making first class observations The year 1828 found Dudley of Lexington, Kentucky, operating on five cases of post-traumatic epilepsy Ten years later the great Richard Bright was writing that he could see, in the brains of epileptics suffering from unilateral convulsions, cortical changes on the contralateral side Meantime, in 1831, Heyman had removed a tumor affecting the brain, and thereby cured a patient of focal epilepsy

While Gall and Spurzheim were localizing sex to the cerebellum, some very important discoveries were being made in that ancient medical school, and cradle of the liberal international spirit in medicine, Montpellier Here, before the Meridional Medical Congress of 1836, a general practitioner, Marc Dax read his paper *Lesions of the Left Half of the Brain Associated With the Loss of Signs of Thought*, or aphasia He had been studying cases with loss of speech since he was twenty-four years old, and by the age of sixty he is said to have described 140 patients Some of these were sent to him for study by Baron Larrey, surgeon to Napoleon's armies (see page 3) Perhaps because Dax was a 'Legitimist" in French politics, he was unpopular in Montpellier at the time of giving his paper At all events it was not published, but remained in the possession of the Dean of the Faculty of Medicine there In the controversy concerning aphasia and cerebral localization which developed twenty-five years later in Paris, the son of Dax, himself a doctor, published the original 1836 manuscript It is clear from this that Dax understood very well the import of his post-mortem observations Though he searched, he was not able to find a single case of destruction of the right hemisphere in a right-handed person suffering from aphasia This is very important

Who was Dax? He was born in Tarascon-sur-Ariège and studied medicine at Montpellier, not far distant In the Year VII of the Republic (1799), he wrote his graduation thesis on *A Record of the Medical Topography of Aigues-*

Mortes It would seem that Dax was a "pensionnaire escolaire" of that remarkable walled town on the Mediterranean, near the westerly mouth of the Rhone River The middle ages had seen crusade after crusade set sail from the fortress town, hopefully to return, guided by the great lighthouse surmounting the walls Today Aigues-Mortes is far inland, its once-active harbour silted up, and its lighthouse no longer a guide to seafarers The name originally meant, in Provençal, "dead or quiet waters," thus "safe harbour"

Dax's thirty-three page thesis, printed by Jean Martel of Montpellier, is a most interesting account of all the diseases of all the inhabitants of the little walled city for a five year period The cause of death is set over against the name of each person dying in that time, and these mortality tables are a model of clarity This thorough medical student, Dax, attached a set of commentaries, by diseases Thus, he discusses fevers, and the convulsions which they caused in children It is clear that he already had a neurological bias, and he wrote, "Epilepsy seems to be getting more frequent day by day and the convulsions to which children are prone, sometimes leave them with partial paralysis, and sometimes there is added, imbecility" Having worked recently on precisely this syndrome, of epilepsy and residual paralysis, in the laboratory of Professor Henri Gastaut nearby, at Marseille, I am particularly struck with the acuity of Dax, the medical student

It is interesting that another medical student, in his graduation thesis at Paris, in 1827, L F Bravais, wrote on *Researches on the Symptoms and Treatment of Hemiplegic Epilepsy* Many years later Charcot coined the term "Bravais-Jacksonian Epilepsy" to denote focal seizures Some Anglo Saxon writers have dismissed Bravais with a flick of the pen, and have insisted that only Jackson knew what he was talking about Our debt to French neurology, as to all French science, is surely something not to be discharged by such chauvinism

Lest there be any doubt about this debt, let us take up briefly the work of that remarkable medical student Gerdy, who wrote his Paris graduation thesis on the structure and early development of the muscular wall of the human heart seventy five years before J B MacCallum, as a Johns Hopkins student, worked so brilliantly on the same problem Gerdy went on to interest himself in the nervous system, and in 1840 wrote that the seat of consciousness was to be found in the mid brain, a theory re stated today as the result of the recent work of Magoun, Jasper, Moruzzi and others Two years after Gerdy's statement, we find Longet publishing in Paris his *Anatomy and Physiology of the Nervous System of Man and Vertebrates* which Sir Geoffrey Jefferson has called "the most important (book) of the first half of the nineteenth century' Two brief quotations will serve to show what a keen observer was Longet

> "On dogs, rabbits and on some kids we have irritated with a knife the white substance of the cerebral lobes, we have cauterised them with potash, nitric acid etc, we have run galvanic currents through them in all directions without succeeding in evoking involuntary muscular contractions, the same negative results were found in directing these agents to either grey or white matter "

> "However, the pathologist would fall into a grave error of generalising on what experiment reveals if he deduced that, in partial affections of the cerebral lobes of men, all must follow as in these experiences Indeed every day in acute and chronic affections of these organs one sees, on the contrary, epileptiform phenomena supervene, partial contractions of the face, of the mouth To explain the invasion of convulsive phenomena experimental induction leads us to suppose that in men disease can stir in the bosom of the brain irritations such as artificial and immediate stimulation cannot provoke"

King's College Hospital in London has had a succession of clinical neurological observers which it would be hard to

equal Much of the history of cerebral localization is to be read in the works of R Bentley Todd, David Ferrier, Macdonald Critchley, Denis Hill and Samuel Nevin We still speak of 'Todd's paralysis' following a unilateral convulsive episode, more than a century after his description of it In 1840 he used what he called a "magneto electric rotating machine" to produce Galvanic stimulation of the brain in rabbits by means of little penetrating electrodes He wrote

> 'Having passed fine bradawls into the cranium in such a direction as I had previously satisfied myself would lead to this organ, (the mid brain), I subjected it to the influence of that machine, general convulsions were produced of a character essentially different from those which resulted from stimulating the spinal cord and the medulla oblongata They were combined movements of alternate con traction and relaxation, flexion and extension, affecting the muscles of all the limbs, of the trunk, and of the eyes which rolled about just as in epilepsy On inserting the awls into the hemispheric lobes still different effects were produced by the application of the machine I could observe noth ing like convulsions but slight convulsive movements of the muscles of the face took place which were no more than what would be caused by the stimulus of galvanism acting upon the nerves of the face
>
> "These experiments, which I repeated several times, and each time with like results, seem to denote that convul sions are modified according to the part of the cerebro spinal axis which is primarily excited"

Again, the lack of knowledge of the history of a subject raises its head and we find that Todd's remarkable work remained unknown twenty years later to Hitzig and presumably to Ferrier also This is very difficult to understand

Meanwhile Fluorens' disciples went on chanting their leader's woolly statements, such as these, "All sensations, all perceptions and all volition occupy concurrently the same seat the faculty of sensation, perception, and volition,

able to confirm the six-layered arrangement by Baillarger with the naked eye eighteen years earlier, and he also designated the three major cell types pyramidal, spindle and granular, names which we employ to this day The little twenty-seven page thesis with two pages of his own illustrations, has become a landmark

While we are on this subject we might pursue it to its logical conclusion without adhering to a chronological account The Viennese psychiatrist Theodor Meynert (1833–1892) showed that one area of the brain was endowed with a covering of white matter, this he called the archipallium The other was covered with grey, and this was named the "neopallium" He also remarked upon the large number of Berlin's "granular" cells in certain areas of the cortex, which we now regard as sensory in function However, Meynert left to the Russian investigator, Vladimir Betz (1834–1894), the discovery, in 1874, of the giant pyramidal cells of the motor cortex After examining 5,000 speciments of the human brain, in embryos, newborns and children, he compressed the report of his great labour into a total of ten printed pages, surely an art which we have lost today The atlas which Betz planned was never published so that it was not until 1878 that the morphology of the large cells, now regarded as motor, on the pre-Rolandic convolution of the human brain, was figured by William Bevan-Lewis His paper appeared in the first issue of the great British neurological journal *Brain,* which has ever since maintained the high standard set by such papers as this "original" At the time of his discovery he was Pathologist to the West Riding Lunatic Asylum and could count among his associates in his work there such giants as Ferrier, Clifford Albutt (later Regius Professor at Cambridge) and Crichton Browne

Further additions to the mosaic of truth concerning the finer structure of the human brain came from the twenty-eight year old Carl Hammarberg in Sweden His book on the anatomy of the brains found in mental hospitals, as

against normals, was published two years after his premature death. He clearly distinguished between the histology of the sensory and motor areas In contradistinction, the long lives of Oscar and Cecile Vogt have produced not only a mass of original observations but a whole school of workers in this field, including the brilliant Armenian, Korbinian Brodmann

While A W. Campbell, an Australian working at Rainhill Asylum near Liverpool with Sherrington's encouragement, recognized twenty separate cytoarchitectonic areas in the human brain, Brodmann claimed that there were fifty two Two years after the publication of Campbell's classic atlas, *Histological Studies on the Localization of Cerebral Function* (1905), another Australian, Grafton Elliot Smith, while serving as Professor of Anatomy at Cairo, outlined twenty-eight distinct areas by gross examination, and twice that number by using a hand lens And so it has gone, the Vogts claiming to have found over two hundred fields by combining the cytological approach with the study of areas rendered distinct by their pattern of myelination Thus, to *cytoarchitectonics* has been added *myeloarchitectonics* And to take things one step further, it could be said that the classical studies of E Horne Craigie in Toronto, and of Cobb and Talbott in Boston, have given a secure foundation to angioarchitectonics, if such a term is needed to describe their work on the relative vascularity of the cerebral cortex The pioneer work of Pope and Folchi Pi at the MacLean Hospital laboratories in Waverley, Massachusetts, has shown the distribution of certain enzymes by layers in the cortex, probably corresponding to synaptic chemical processes

The time has come to break out of the straight jacket imposed upon our thinking for so long by classical neurohistologists interested only in the relative position of cell bodies in the layers of the cortex Function depends on synapses, and there are relatively few synapses on cell bodies in some parts of the cortex, notably in the cingulate gyrus, as our recent

studies in Vancouver have shown Many cells receive synaptic stimulation on their far-flung dendritic processes, which, in area, far surpass the cell's perykaryon There is a paucity of boutons terminaux on or near the Purkinje cell bodies, as against the profusion of ringlike endings to be seen with silver stains, over the tree like dendrites of these large cerebellar cells While the functional anatomy of the entire cerebral cortex has still to be documented histologically, neurophysiologists have for years been recording with great accuracy the level at which electrical events take place

So far, discussion has been focussed on the vertical distribution of grey matter and its constituents The story of examining the horizontal distribution, and of calculating the area of grey matter on the surface of the human brain, is well-nigh incredible Wagner in 1862 covered the exposed cortex with gold leaf, then removed it, set it out on a firm horizontal surface and measured its area His two sons assisted with the work, and they finally decided that the human cerebral cortex has an area of 200,000 sq mm, two-thirds of which is buried Danilewski, on the other hand, invoked Archimedes' principle to ascertain the weight of the grey matter as against the white, and after calculations involving mean thickness and so on, he agreed with Baillarger's 1845 estimate, i e, an area of 170,000 sq mm To complicate things, or rather to show how complicated the cortex is, Eccles has now estimated that one cell therein can influence 780 other cells, and that each cell, on the average, has one hundred synaptic endings on it The astronomical proportions of this arrangement should make our computer-analogy colleagues quail They probably wish for the return of the "good old days" of cybernetics, when Wiener was king

We must now pick up the story of speech localization from the days of Marc Dax in 1836 His read, but unpublished, paper remained in the Faculty of Montpellier for a long time before Paul Broca, the Paris surgeon and anthropologist, looked at it Sir Geoffrey Jefferson says that Broca did not

grasp the importance of damaged left hemispheres in aphasic patients until he saw Dax's paper. Broca was one of the most interesting and controversial figures of the middle of the last century in Paris. His teacher Bouillaud was interested in Gall's phrenological designation of the orbital surface of the frontal lobe in man as the speech centre. Bouillaud offered a prize of 500 francs for *anyone who could* produce the brain of an aphasic *without* a frontal lobe lesion. Broca reported to the Anatomical Society of Paris in 1861 the brain of his famous case Tan Tan, who had suffered from aphasia and at autopsy showed a lesion on the inferior frontal convolution on the left side. In 1874 Wernicke announced that the superior temporal gyrus was the area of the human brain given over specifically for the reception of sound. I mention Broca's area and Wernicke's area *seriatum* merely because the ever-skeptical Pierre Marie, at the turn of the century, went to the Musee Dupuytren in Paris and asked to see specimen No. 55a, the brain of Tan Tan. Marie reported that Tan Tan had suffered lesions not only in Broca's area but in Wernicke's area also!

Matters were coming to a boil before Broca's pronouncement, but after his communication the debate became fierce *in Paris and in other parts of the world.* One year previously, i.e., 1860, Hughlings Jackson had shown that a diseased hemisphere might give rise to involuntary contralateral movements. Thereafter, he concentrated on focal seizures rather *than upon major fits or "dramas of great human interest," as he called them.* As all the world knows, Jackson studied patients with focal seizures so assiduously that he built up a picture of how the body must be represented, upside down, on the motor cortex. He deduced also that there must be cortical representation of certain visceral functions, from his clinical observation of seizure patterns. His views on "levels" of neurological function were later to influence Freud in his views on levels of consciousness. One of the riddles of the spheres is still the so called "Jacksonian march"

of the electrical disturbance into the motor area and then downstream to the limbs The impression must not be left that Jackson was interested only in motor seizures He was interested in all *focal* seizures, as, for instance, in 1863, in a patient with a sensory seizure involving only one thumb He placed its causal lesion behind the Rolandic fissure

The delineation, in 1870, of the excitable cortex on the surface of the dog's brain, by Fritsch and Hitzig, two thirty-two year old teachers in Berlin, was the signal for a great forward leap by neurophysiologists The news spread as rapidly as had the news of ether anaesthesia twenty-four years previously These two pioneers soon mapped the excitable cortex in the monkey The thirty year old David Ferrier in England began his finely detailed work on the monkey, and it is a pleasure to read his description of the multitude of small movements which suitable stimulation provoked The clinicians were not idle, either, and in far-off Cincinnati, Ohio, we find Dr Robert Bartholow, Professor of Medicine, in 1874, applying electrodes to the human brain for the first time His subject was a house maid, who was dying from an eroding cancer of the scalp and skull Using a weak faradic current he was able to produce movements of the limbs of the opposite side of the body and head turning to that side When he published an account of his work he was ostracized from medical circles in Cincinnati Two things are remarkable about this, the first is the anti-scientific streak in our profession at times, and a desire to admit nothing new, the second is that this isolated and persecuted practitioner in Ohio was much nearer the truth than many men in protected positions within great institutions of learning It makes one realize what sound reasoning was Harvey Cushing's when he suggested that the medical curriculum be reversed, and that two years of clinical observation should precede two years of laboratory investigation We shall return to this theme in other chapters

Then, in 1875, there came on the scene a man of great

talent, not appreciated in his native England at first, Richard Caton of Liverpool He recorded for the first time in history the spontaneous electrical activity of the brain, in rabbits and monkeys He found that light falling upon the retina immediately increased the electrical activity of the visual area of the cortex His work was confirmed by Dewar and M'Kendrick, but (like that of Danilewski in Russia and Beck in Poland) seems to have been forgotten until Hans Berger in 1924 recorded from the human brain through the intact scalp and skull. Lord Cohen of Birkenhead has recently written a delightful biography of Caton in the *Proceedings of the Royal Society of Medicine* in London, from which it becomes obvious that this was a great medical pioneer, educator, historian and public servant

It is interesting that David Ferrier knew of the stimulating effect on the occipital cortical blood supply of a flashing light in front of the retina The capillaries dilated in response to physiological need, as he saw it I want to recount to you briefly a similar observation made by John Fulton in 1927 at the Peter Bent Brigham Hospital in Boston when he was on Harvey Cushing's service A sailor, Walter Kruger, had come in, one year previously, with a right visual field defect, headache and a humming noise or "bruit" behind his left ear Dr Cushing tried to remove a large vascular tumor from the left occiput, but loss of blood made it impossible He therefore stopped at decompression, and the sailor left hospital much improved A year later he was recalled for study, at which time Dr Fulton took electrophonograms of the "bruit," in darkness and when Kruger was exposed to a bright light The difference was very striking, and shows once again how beautifully inter-related are blood supply and neurological function

Harvey Cushing, in his post graduate days with Sherrington in Liverpool, had become very interested in localizing cortical function in anthropoids on the operating table In 1909, in Baltimore, he began operating upon humans under

local anaesthetic in order that he might hear, from the patient, a first-hand account of what cortical stimulation was doing He early noted that stimulation of the sensory cortex might produce "feelings" of touch and pressure, it never produced pain In the First World War, Sir Henry Head was to elaborate this theme over and over again, as he studied "discrimination" subserved by the cortex, as against pain involving thalamic structures Parietal lesions, in his view, never produced anaesthesia, but rather, changes in shape recognition and two point sensation

The spectacular progress made in the twentieth century on localization of function in the brain through electrical techniques of recording from it, and, conversely, of stimulating its parts, has only been possible because modern workers have stood upon the shoulders of the last century's giants Caton, Beck, Sechenov, Bechterev, and Cybulski Their contributions and their lives have been so well described by Dr Mary Brazier in her recent volume *A History of the Electrical Activity of the Brain,* that it would be redundant to attempt to detail here even a tenth of the fascinating story which she has unfolded The logical development of this early labor, in the hands of John Fulton, Dusser de Barene, and their students, working on primates at Yale University, has led to further useful knowledge being harvested, against the day when it can be fully applied to humans

Progress in understanding the form and function of the human brain in the living person has gained great momentum in the first half of the twentieth century through the pioneering zeal of Wilder Penfield and the dedicated group of fellow students which he has assembled at the Montreal Neurological Institute In this hospital and laboratory setting, built and maintained by McGill University, it has been possible to map in great detail the localization of function in the brain of the conscious patient undergoing the surgical removal of damaged tissue for the relief of epileptic seizures A few jaundiced minds in England have suggested that this

is 'experimenting on humans This view, as ignorant as it is irresponsible, has not found any support, happily for scientific progress, and, instead, Montreal has become the modern Mecca for well trained researchers from the four corners of the earth, interested in pursuing the work and thought of the pioneers in the field discussed in this chapter

For the literally minded who require finality in all things, there resides little comfort in the study of the brain Well hidden by a bony vault, a tough scalp and sometimes an impenetrable coiffure, the brain smiles indulgently as generations pry into its secrets The clinical investigator sometimes wonders how to interpret or to synthesize into a viable concept the flood of facts now swamping the medical literature Perhaps he can seek solace in the words of Oscar Wilde

> "There are works which wait, and which one does not understand for a long time, the reason is that they bring answers to questions *which have not yet been raised, for* the question often arrives a terribly long time after the answer"

Chapter VI

The Study of Physical Factors in Mental Disease

> *First, therefore, in this, as in all things which are practical, we ought to cast up our account, what is in our power and what not, for the one may be dealt with by way of alteration but the other by way of application only The husband man cannot command, either the nature of the earth or the seasons of the weather, no more can the physician the constitution of the patient, nor the variety of accidents So in the culture and cure of the mind of man, two things are without our command, points of nature, and points of fortune*
>
> BACON

FOR whatever reason, the field of causal mechanisms in mental illness is shot through with ill disguised hostility, and a long suffering public is left in a quandry as to what science has to offer One week it is all chemical and the next all psychogenic, so much so that a mere investigator in this field shrinks from putting his head out of his foxhole lest he lose it in the cross fire This highly charged atmopshere, however, reflects the hopes which men have harboured for thousands of years, not merely hundreds, that causes would be found which would lead to cure or amelioration of this, the most costly set of diseases in the world

The sad fact of our time, when pieces of hardware costing untold millions are being shot off into the air, in a programme costing further untold amounts to organize, and even more to man, with people educated at a cost of further untold millions, is that less than one per cent of the cost of mental illness to the state is being spent on research into its causes

Large corporations could not possibly operate in this way, and America's largest industrial empires know that they must plough into research many times this slender portion of their earnings if they are to remain solvent The idea of spending money to save money, so long accepted in industry, dawns slowly in the neglected field of mental health research It all suggests the possibility that our attitudes, as citizens, are not too far removed from what we casually dismiss as the magic or witchcraft of ancient times

The history of attempts to account for the existence of mental diseases is full of recurrences of fantastic "explanations" and, unfortunately, very few facts The leading actors on the stage are always positive, and occasionally right

It would be wrong to suggest that no progress has been made in this field Ten per cent of the mental hospital beds of the country have been emptied permanently by one substance, *penicillin Little did Howard Florey realize, that* the blood, sweat and tears which he and his team put into their productive effort at Oxford, would change not only the course of World War II, but also the lives of millions who would otherwise be treated with various fever therapies in mental hospitals for general paresis of the insane

I cannot resist the temptation, either, to point out that a medical student, Antoine Laurent Bayle, in his graduation thesis of 1822, first put his finger on the pathological changes —the chronic meningitis—to be found in this disease We had to wait nearly one hundred years thereafter for the Japanese investigator, Noguchi, *to demonstrate the spirochaete* in tissues of the nervous system by silver staining methods Nor did Fred Banting, slaving in an attic in Toronto with his loyal graduate student Charles Best, almost forty years ago, ever imagine that the anti diabetic principle which they sought in the dog's pancreas, was some day to be used in every mental hospital in the world in an attempt to alleviate schizophrenia It is still not realized in many quarters that this was a great surgical triumph, for Banting was a surgeon

who was able to do what no previous experimenter had been able to do He was not only a surgeon, he was tough minded, and was able to weather the storm of abuse which broke over his head from many self-important people It is reminiscent of the type of abuse which is meted out today to pioneers in mental health research The most unfortunate by-product of all this is that it becomes harder and harder to recruit new people with serious research interests, they turn to medical practice where the sick, at least, render gratitude, and away from research projects plagued by officials

As in so many other parts of medicine, clear statements of the problem start with Hippocrates, who, in writing on "the sacred disease," epilepsy, propounded natural causes, as against supernatural He said

> "They who first referred this disease to the gods appear to me to have been just such persons as the conjurors, purificators, mountebanks and charlatans now are, who claim great piety and superior knowledge Such persons thus use the divinity as a pretext and a screen for their own inability to afford any assistance'

This thin thread is to be found through most discussions of mental illness until the 18th century Because Galen (130–200) showed little insight into mental phenomena, the field made little progress His authoritarian views stemmed from a study of monkeys It is true that mental diseases were dealt with in books on general medicine, however Celsus in the first century A D, for example, devoted a chapter to melancholia and mania, though it largely concerned treatment and I regret to say the treatment which he condoned was often nothing more than sheer physical cruelty Aretaeus during the second century wrote on melancholia, mania, and what he called "phrenitis" Similarly, Soranus of Ephesus discussed the same three problems, and placed the lesion or lesions responsible in the brain, in the head generally, or in the aorta Phrenitis was associated with fever, while mania

was a disturbance without fever He made it clear that the "gay" and "sad" forms of other writers were not to be entertained, and he divided the field into forms associated with tension, and those with relaxation He repudiated the philosophers' view that it was a disease of the soul Part of his treatment consisted in travel, the playing of chess, and practice in speaking to 'friendly audiences"

Melancholia was interpreted by Soranus, an obstetrician and gynaecologist, as 'black rage," not as "black bile" He remarked on its prevalence in middle aged men, considering it a disease of the oesophagus Aretaeus, on the other hand, made some acute observations on the transition from melancholia to mania in some cases, and on its life long nature in others He also discussed abnormalities in perception, believing it to be disturbed in "phrenitis," and misinterpreted in mania and melancholia His description suggests a keen eye

> "The patient may imagine he has taken another form than his own, one believes himself a sparrow, a cock, or an earthen vase, another a god, orator or actor, carrying gravely a stalk of straw and imagining himself holding a sceptre of the world Some utter cries of an infant and demand to be carried in arms, or they believe themselves a grain of mustard, and tremble continuously for fear of being eaten by a hen, some refuse to urinate for fear of causing a new deluge"

His mention of hysteria is one of the earliest descriptions of that state

Now the background of many of the observations which will be discussed in later times was coloured by one amazing thing, *the right of the physician to refuse treatment to a mental patient because the disease was probably incurable* This medical "Fifth Amendment" reflects the state of mind of the profession, and more than that, the cloud of hopelessness which must have descended on patients who were beginning to experience minor difficulties It is little wonder, then, that a field almost vacated by medicine should fall un-

der the malign influence of self appointed witch hunters These seriously disturbed people had not far to seek for devilish methods of treatment, for even the revered layman Celsus accepted ducking, whipping, and torture as suitable therapy

When, therefore, borne by the Galenic tide so much despised by Vesalius, we arrive at the Renaissance, we find mental patients abandoned to people who believed possession by devils to be the cause of their troubles The combative barbers had taken over surgery, and the milder mannered physicians were displaced by a wave of inquisitors The Greek influence represented in the teachings of Hippocrates, retreated to the mental hospitals, or it would never have survived Some of it was restored to Europe through translators at Monte Cassino

As medical practice migrated in the direction of clerics, so, too, did the climate change to one of magic, superstition and revelation Witch hunting became a regular discipline,* and a handbook on it was published by two Dominicans, Kraemer and Sprenger It is said that even men of the stature of Jean Fernel and Ambroise Paré were caught up in this frightful business Against it stood Conrad Gesner, Paracelsus and Johann Weyer Beginning in Germany, this movement for the employment of malignantly disturbed misfits as inquisitors took the lives of thousands of sufferers from various kinds of neurological and psychiatric illnesses It remains still as the basis of the police state

Thus, Paracelsus found himself up against the clergy when he published his book in 1567, *Diseases Which Lead to Loss of Reason* He had committed the sin of regarding mental diseases as due to natural causes His treatment of the problem was not by any means as superficial as one might think on first colliding with the author's name Theophrastus Bombastus von Hohenheim On the contrary, he listed five types of epilepsy, according to the sources the brain, the liver, the heart, the gut and the limbs He described as distinct entities

faints and seizures, sudden versus gradual falling, frothing at the mouth and urinary incontinence. He dispensed with the four humours and four temperaments, and said "the truly insane" were born mad. He could not allow the name of a Saint, in this case St. Vitus, to be attached to a widespread disease, because, in his view, Saints were above causing diseases. His explanation of the disease, however, leaves us puzzled. He attributed St. Vitus' dance to the precipitation of irritating salts "in the veins of laughter." As a chemist he was keen on chemotherapy, and he also gave what some regard as the earliest interpretation of cretinism as related to goitre. He was humane enough to appeal for an understanding of so called "fools," and for the saving of witches, rather than their burning.

Felix Plater (1536–1616) was one of the first to return to the Greek view of natural causes, and he devoted 150 pages of his book on medical practice to psychiatric problems. He notes, interestingly enough, that one case of stupor showed a brain tumor at autopsy. Despite the growing emphasis on investigation of the true nature of mental diseases, witch-burning still went on until forbidden, in France at least, by the King, in 1680. This was the period when Sydenham, Cheyne, Trotter, and others were comparing notes as to the proportion of their practices made up of hysterical cases. It was also the time of Thomas Willis, who, though able to describe dementia paralytica, still could write, "maniacs often recover much sooner if they are treated with torture and torments in a hovel instead of with medicaments." While Willis' pupil, Christopher Wren, was pioneering blood transfusion in animals, Professor Jean Denis in Paris was proposing to transfuse sheep's blood into the veins of mental patients. This must have been the original "shock therapy" for it killed several before it was prohibited. And yet it was not the original shock therapy, for we must recall the application of electric fish to the head of mental patients in Rome in the first century, with therapeutic discharges.

Gradually, the God of Reason began to be worshipped by the philosophers, and even physicians began to doubt the theory of the incurability of mental cases The chains were struck off patients in Geneva and in Italy, then by Pinel in Paris and by Tuke in England However, a backward step was taken in the study of causation when George Ernst Stahl, who spawned the mischievous "phlogiston" theory, now came forth with the doctrine that the physical and chemical processes of the body were kept up only through the soul and its influence This anti-Hippocratic teaching lasted until Lavoisier's day In the chemical field it was the humble Joseph Black who put an end to Stahl's views in the course of writing his memorable graduation thesis in Edinburgh on his discovery of carbon dioxide

As new physiological discoveries were made, such as Haller's on the irritability of nerve and muscle tissue, so did a cloud of "explainers" ride in on the discoverers' coat-tails William Cullen, Black's teacher, coined the term "neurosis" and saw everything as explained by abnormal processes within the nervous system The work of Whytt, Galvani and Volta, on nerves, furthered this relationship between "neurosis" and "nerves," so that the words became almost interchangeable in the lay mind Cerebral localization found the same group of hovering birds ready to descend on it, in the guise of "phrenology"

Nevertheless, some brave souls appeared, who saw the advances in neurophysiology as offering a mechanism though which psychological phenomena might yet be explained This was indeed a hopeful break in the clouds The one deterrent to progress in the mental field continued to be the obsession with pigeon-holing and systematizing of everything This blind pouring of new wine into old bottles was inevitably to lead to explosive change One of the great figures in the forward move was, of course, Philip Pinel He was of that tough and erudite stock in the southwest of France, whence came such giants as Baron Larrey and Es-

quirol Pinel, above all else, believed in the possibility of *curing* mental illness In addition, he was an observer, not an "explainer" He clearly recognized psychological factors as speeding the onset of mental illness, and he weighed up environmental factors, such as "a faulty education" He remarked on the causal effect of conflicts between human instincts and religious dogma He wrote about the effects of alcoholism, amenorrhoea, fever, the puerperium and head injury He described to perfection a case of aphasia, agraphia and alexia He attempted to put an end to the idea that mental patients were 'possessed' by devils Disturbances in perception, memory, and associational processes did not escape his remarkable eye He knew of the relationship of cretinism to "idiocy" While he searched for organic brain damage, and even for abdominal abnormalities, he nevertheless recognized the role of psychogenic factors He remarked that physicians and mathematicians rarely developed insanity, while artists and monks seemed to suffer from occupational diseases! He was an excellent physician and knew that other diseases might supervene to delay a cure of mental illness

Pinel's pupil Esquirol, would have none of the then abdominal localization of any mental disease, and, under the impact of Gall's early doctrines, became interested in cerebral localization He would not have alcoholism listed as a cause, either He saw it as symptomatic only. Psychogenic, sociological and environmental factors were seen as potent causal factors

The early nineteenth century brought a fracturing of psychiatry in Germany right down the middle, with the romantic movement of 'psychicists" on one side, and the somatically minded on the other Causal mechanisms were speculated upon to the exclusion of good research For the romantics, sin was the cause most often designated The soul was assigned boundaries, polarity, and a number of other attributes, and "unbridled passions" were denounced as malign factors One can see the old theory of "possession" sneaking

in, by the side door On the other hand, the somaticists regarded mental illnesses as mere by-products of systemic disease, such as heart disease Therapy, can we wonder, consisted in dumping two hundred buckets of water over a patient at each treatment

Reform of this sad picture began with a twenty-five year old German, Wilhelm Griesinger, who joined with the surgeon Roser, and the internist Wunderlich, in launching the *Archiv fur Physiologische Heilkund* Griesinger started medical school at the age of seventeen years, and promptly stopped going to lectures He said, "I'd rather read Muller's physiology than be dictated to by old theories" He thought that predisposing causes set the stage and that intercurrent illnesses precipitated mental illness He recognized the potent influence of early experiences Whereas his predecessors had implicated *hyperemia,* he looked upon *anemia* as an important factor He was interested in pellagra, post-partum psychosis, heart disease and gastrointestinal disease He was against extremes and produced a middle of-the road discipline, neuropsychiatry More important than this, however, he regarded pathology as process, the underlying spirit of the modern school of pathology which Sir Howard Florey has assembled at Oxford today Griesinger represents the necessary and inevitable transition from institutional psychiatry to university psychiatry in Germany The need for this transition in British psychiatry in 1815 can be imagined from the following statement by Dr Thomas Monroe, Physician to the Royal Bethlem Hospital, to a Board of Enquiry

> "The patients are ordered to be bled about the latter end of May or the beginning of May according to the weather And after they have been bled they take vomits daily or every other day for a certain number of weeks After that we purge the patients This has been the practice invariably for years, long before my time, and it was handed down to me by my father, and I don't know any better practice"

The works of Kraepelin, Nissl and Alzheimer at Heidelberg are too well known to require more than mention here So much nonsense has been written about Kraepelin that it is a pleasure to record that Clarence B Farrar, of Toronto, the editor of the *American Journal of Psychiatry*, has at last put pen to paper, to tell what it was like to study with these giants at Heidelberg From this delightful, first hand study, one can see Kraepelin's life long drive to contribute As an undergraduate he won a prize for his essay *The Influence of Acute Somatic Illness on the Development of Mental Disorder* Very honestly Farrar adds, "No one else competed" At the age of twenty seven, Kraepelin produced a thin little *Compendium of Psychiatry* during the Easter holidays, again, as Farrar admits, because he needed the money! However, by the end of his career, his compendium had grown to four volumes containing 2,372 pages

While studying with Wundt, the psychologist, Kraepelin did many experiments on the effects of toxic substances on animal behaviour He believed in external causes of mental disease, and you can be sure he would put alcohol first He really had a phobia about this, and was the butt of many pranks by his laboratory colleagues as a result. Metabolic factors, exhaustion and fevers were repeated in his list, too The internal factors or predispositions he saw as sex, age and occupation The "personal" factors, specific for an individual, were heredity and "faulty upbringing" He had some racial views reminiscent of Morel's degeneration theory However, Farrar says these never obscured the eye of Kraepelin the great observer He is dismissed by many as the father of "descriptive psychiatry," as if this were reprehensible The fact is that he was the father of a revivified psychiatry based on observation He knew the natural history of mental diseases as few have done since Our modern classification of the major psychoses as manic depressive on one hand, and dementia praecox on the other, stems from his observations and deductions

Coming to the French scene of last century, Charcot stands out as a commanding figure in neurology He seems, however, to have gone beyond his depth in "explaining" hysteria He said it was an hereditary disease of the internal capsule of the brain, which produces seizures, triggered by pressure over the ovaries! With this pronouncement, the sky became black with surgeons descending upon, and ovariectomizing, a generation of women The literal meaning of "hysteria" had been "wandering uterus," and now Charcot included in this senseless scheme, the ovarian tissues bilaterally.

It is with trepidation, therefore, that I mention that in his old age Pavlov took up the study of psychiatry in an attempt to understand mental diseases as disordered conditioned reflexes The direct relationship of his work to clinical psychiatry, is thought by many, to await confirmation It would be surprising to me if the basic truths which he has demonstrated concerning animal behaviour had not some relationship to human problems

Coming now to more modern times, it is difficult to know where to begin Electroencephalography is said, by some very respectable historians, to have aided in no manner whatever in understanding mental disease This is unfortunate In this, historians have taken the views of ultra-somatically minded electroencephalographers Margaret Kennard, for instance, has been a pioneer in the tough business of recording from patients in mental hospitals, and of analysing these records systematically. The lack of organization of EEG records in schizophrenics seems to me well established In the field of temporal lobe diseases with a variety of clinical problems, among them aggressive sexual psychopathy, the EEG has been of the greatest service, thanks to the pioneering of Denis Hill at the Maudsley Hospital in London One cannot too highly praise the work of this thoughtful researcher and the group of colleagues around him—Pond, Dawson, Kennedy, and Falconer They are not trying to ex-

plain everything to everyone in one fell swoop, they are trying to *observe*, and let no one make any mistake about it they are helped to observe well, by the arrangements under the National Health Service accorded to teaching hospitals Across the hall one finds at the Maudsley, the dedicated group of chemical researchers under Professor Henry McIlwain They are not running about Britain debunking the efforts of their colleagues They are trying to "bunk" something instead, and in this they are encouraging private donors to help in the fight for better research facilities and opportunities They are not shaking the faith of governments, universities and foundations in the necessity of this research, by petulantly holding up to public ridicule a few pieces of unrepresentative and poor work

Neurochemistry is coming into its own in the United Kingdom, thanks largely to the mental health authorities and the defence authorities It is almost one hundred years ago that the father of neurochemistry Johann Ludwig Wilhelm Thudichum began his work in London, in an effort to find the cause of the distressing mental symptoms of the victims of cholera, a disease which was so prevalent in London in the 1860 s There was then no bacteriology, and precious little microscopy worthy the name It is all the more amazing, therefore, that this political refugee from Germany set out to isolate compounds from the brain of the ox, in an effort to explain coma, delirium and other problems in infectious fevers The whole work was financed by the public health laboratories under the benevolent eye of the reformer, Sir John Simon Before he died, Thudichum had isolated 140 chemicals from the brain He eventually had to give up research and go out into practice to support a wife and six children Nevertheless he kept some investigation going even then, and wrote several very useful books on chemical pathology

Having dealt with many of the microscopic anatomists who have contributed to an understanding of organic men-

tal problems, we should hasten on to the chemists, but not before saying one word about the late-lamented Godwin Greenfield, who died in Washington in 1957 shortly before he was to join my laboratory in Vancouver His work on lethargic encephalitis, on demyelinating diseases, on hepatolenticular degeneration, on amaurotic family idiocy, pellagra, presenile dementia, and the pathology of measles encephalitis, mark him out as a great scientist interested in mental illness

My colleagues Dr Edith and Dr Patrick McGeer have recently published an analysis of 130 papers written since the turn of the century on the physiological effects of schizophrenic body fluids These papers demonstrate the attempts, by a large group of workers, to do several things (a) elicit caricatures of "catatonic" symptoms in animals, (b) elicit changes in trained responses or in behaviour of laboratory animals, (c) demonstrate toxic effects of such fluids in animals, plants, and tissue cultures, (d) to investigate the hyperglycemic effect of such extracts in animals, and (e) to test the toxic effects on enzyme systems *in vitro* All the con troversial hypotheses and experimental results of Heath, Hoffer, De Jong, and several hundred others have been noted briefly in this review, so that students of this subject today may refer to them readily

It would be hazardous to prophecy what the immediate future may yield in the field of physical factors involved in mental illness We must guard against the orthodoxy which inevitably steals over any advancing field after one generation of hard work As Charles Singer often said, the ancients suffered from too many theories and too few facts Today, our major problem may be one of the inadequacy of present technical methods to match the complexity of the processes to be unravelled This may have been in the mind of J J Abel, the distinguished pharmacologist of Johns Hopkins University, who isolated adrenalin and investigated such problems as alcoholism and hyperthyroidism, when he wrote,

"Greater than even the greatest discovery is to keep open the way to future discoveries." His injunction has special significance today in the complex and important field of mental health.

Chapter VII

Some Canadian Physicians

IT WOULD seem most appropriate to begin this discussion on Canadian physicians with the career of William Osler, whose active life of seventy years embraced ten years of teaching in Canada, twenty in the United States, and almost fifteen in Britain Thanks to the elegant biography of Osler written by Harvey Cushing, generations who never knew Osler may know intimately of his life and works His Boswell did him well, and how much there was to do! Osler came of remarkably tough stock, his father being a Cornish sailor who took Holy Orders, and his mother, after the trials of the Canadian wilderness of a century ago, living to the age of 100, after raising nine children of which William was the youngest

Sent to the wilds of Ontario by the Anglican Church, Featherstone Osler proved to be one of the wisest and sturdiest campaigners any church ever found He dispensed the Gospel, the laws of the land, medicine when necessary, and always consolation in an untamed and heartbreaking country His son William was to do the same, in a slightly differing order

William Osler was born in 1849 about one hundred miles north of Toronto in what was called "Upper Canada," near the birthplace of William Banting, whose son Frederick we will discuss presently Osler's olive skin and jet black hair made him indistinguishable from the Indians, and his antics, throughout most of his life, were of this persuasion Even Oxford was treated to some of his escapades, but they

had suffered wild colonials for so long there that little offence was taken As a very young boy Osler and his schoolmates in Ontario had spent a night in jail for smoking out the matron of their student residence However, he had one of Canada's finest criminal lawyers, in the person of an older brother, to extricate him In fact, Osler was conveniently supplied with brothers, one of whom extricated him often and generously from booksellers and their wiles Lest it be thought that the great Osler Library at McGill was thus acquired, I hasten to add that Osler importuned not only his banker brother, but also wealthy patients and friends, in the interests of many libraries other than McGill's Many of the finest collections in the United States were revivified by his all pervading spirit Auditoriums and hospitals have been named in his memory "Why? asks the medical student of today 'What did Osler discover?"

To answer this question adequately would take a long time But we can certainly say that he early discovered Mother Nature to provide a most interesting study His "ink-pot career' began at the University of Toronto, when he published in a British magazine, his little article, *Christmas and the Microscope* He had been examining, under the high power lens, the scrapings from an old barrel immersed in a stream which wanders beside what is now a busy highway near Dundas, Ontario, on the route from Toronto to Niagara Falls Even before this he had been grinding specimens of stone, teeth and fossils for his erudite school master, the Reverend W A. Johnson, godson of the Duke of Wellington Under his influence Osler began theology in Toronto but after a year transferred to medical studies, where he soon distinguished himself by discovering the pork parasite, Trichina Spiralis, in the cadaver which he was dissecting Not content with the mere discovery of the parasite, he sought to infect several types of animal with it, and was successful in the rabbit Sir James Paget had first described these creatures thirty five years earlier, when he, also, was a first year

medical student in London, but of this information Osler was completely ignorant He sought the broad clinical opportunities of McGill in 1870 and graduated there in 1872, presenting a notable thesis, illustrated by thirty three specimens It was awarded a special prize, but as his nephew Dr W W Francis used to remark, "The lid came off a few specimens, and I think a special prize for olfactory stimulation was in order"

After two years of post graduate training with the best minds in Europe, such as Rudolf Virchow in Berlin, and Burdon Sanderson in London where he did original work on the role of the blood platelets, Osler returned to Canada, and for some time was a general practitioner in Dundas, his home in Ontario This is generally overlooked as a formative influence in his career He was soon called to McGill, as lecturer in physiology and pathology, and was, in the following year, made full professor He was shocked at the local attitude to microscopic study, and proceeded to spend the $600 stipend which he earned as physician to the overloaded small pox hospital in Montreal, on twelve microscopes for his student demonstrations These classes he was forced to give on Saturday afternoons in the then empty cloakroom of the medical staff! The next year he became pathologist to that superb institution, the Montreal General Hospital with its enormous outpatient service for French and English-speaking sick, as well as for the mariners that plied the great inland seas confluent with the St Lawrence It was here that Osler learned his medicine, and never forgot it The volumes of his pathological reports still in the Hospital's library stagger the imagination, so complete are they, even when handwriting was the only method of recording It was on the wards, however, that this lilting young spirit gradually produced a revolution While older hands saw to it that the ship of clinical medicine had a superabundance of ballast, Midshipman Osler unfurled the sails, and let fresh winds play upon them

When in 1885 Osler went to Philadelphia, his disconsolate students in Montreal insisted on following him for instruction and laboratory work in the summer vacations, surely a tribute to any man It was one of these, the Honorable Henry Esson Young, who built all that is modern in health and education in my home province of British Columbia, today These were the days of Osler's campaigns, both as speaker and writer, in the field of public health Philadelphia was a bit dubious about a young professor who travelled to the hos pital by tram, wearing a top hat and frock coat, and a flaming red tie However, it was his work in the laboratory with his students—investigating malarial parasites in the blood, for example—and his matchless post mortems, which put his teaching on an unassailable plane

Little wonder, then, that the post of Professor of Medicine at the new Johns Hopkins Hospital was offered to this resourceful and fearless new mind in medicine, for Hopkins wanted something new, and that was the teaching of medicine at a graduate school level As Osler used to say, it was as well that he entered as a professor, for he could never have made the grade as a student! The clinical teaching on the wards, with the students contributing to the diagnosis and treatment of patients, made history on a continent that was saturated with medical "trade schools"

In a matter of seventeen months Osler wrote the greatest textbook of medicine which the world has ever known for comprehensive content and beauty of prose It led to the de velopment of the Rockefeller Foundation for Medical Research, just as, later, its author's qualities led to the establish ment of the Nuffield Foundation at Oxford Philadelphia had seen Osler publish thirty nine papers, mostly on infectious diseases Now Baltimore saw him tackle the tougher problems of internal medicine His diagnostic skill became legendary, and finally, in 1905, he fled to England to escape the endless consultations which fell to his lot It is said that he could have been employed full time in seeing physicians

and their relatives only Patients and books dominated his life, as before, and at the opening of the new building of the Boston Medical Library he made his famous remark, 'To study the phenomena of disease without books is to sail an uncharted sea, while to study books without patients, is not to go to sea at all"

While still at Baltimore, Osler was invited to open the new laboratories of pathology and physiology at the University of Toronto He little realized that eighteen years later, Banting and Best would discover insulin in these buildings

By the end of 1905 Osler, now established as the Regius or Royal Professor of Medicine at Oxford, was able to write to his American friends concerning 13 Norham Gardens, the home which he and Mrs Osler purchased, 'The hotel is now in full swing" It was to remain so until Sir William's death in 1919, and came to be known everywhere as "The Open Arms" Since there was no clinical school in existence at Oxford in those days, Osler could spend his time on good works, such as the fight against tuberculosis One day while questioning an Oxfordshire woman at the Radcliffe Infirmary on her family history of tubercle, Osler was able to establish that all immediate relatives suffered from the disease Then, he asked, 'What about your grandfather?' The reply was, 'Ow 'e wuz stillborn, 'e wuz"

Osler took very seriously his role as Master of the Almshouse at Ewelme, fifteen miles south of Oxford, the first Regius Professor to do so since the thirteen old men provided for by Chaucer's granddaughter had been attached to the chair of medicine as "clinical teaching material" The vicar attached to the Almshouse always managed to absent himself whenever Osler wanted to visit the beautiful old timber and brick structure and to examine its charter locked away in a safe Finally, Osler drove down with Sir Charles Sherrington, and finding the clergyman absent, phoned to Chubb and Company, the safemakers in London They dispatched a man by train who, on arrival, asked Osler if he was sure

the old safe, dating from the reign of King James, was actually locked Two raps on the front with a large mallet, and the door swung open, it had never been locked Thereupon Osler took out the rather damp charter and other documents from within, dried them, and had them suitably preserved He converted the loft to a study, where he could hide when the trans-Atlantic boats discharged too many people onto his lawn at Oxford

Osler loved to re-write history, along with his friend E S Martin, the editor of the original *Life* magazine Martin's account of William, Duke of Suffolk, who was married to Chaucer's granddaughter, read, "He entered politics and his body was never recovered" Osler could tell his American friends in confidence that his *Textbook* had sold over 100,000 copies by 1907 He would never mention so gross a detail to his Oxford colleagues, however, for they were already beginning to feel things a little unreal when it was rumoured that this wild Indian from Canada was spending his week ends in America! Certainly Osler made many trips home, and on one of these, in 1909, he remarked prophetically in a speech at Toronto, that as the functional importance of the pancreas becomes better understood "we shall probably be able to place the treatment of diabetes on a surer foundation" On another visit, in 1913, he gave the Silliman Lectures at Yale, on *The Evolution of Modern Medicine*, quite the most serious contribution to medical history which he made While in New Haven he spoke to the students on *A Way of Life*, an address which has been reprinted many times for distribution to undergraduates

With the outbreak of World War I, Osler became the busiest man in Britain, the Agent General for doctors from every part of the Allied world, and "The Consoler-General" for countless overseas relatives of injured men His writings on trench foot, frostbite and war neurosis are still full of wisdom His only child, Edward Revere, was killed while serving with an artillery unit, despite the care of Harvey Cushing

at the last. The end of the war saw Osler blasting the Foreign Office concerning their inactivity in the face of a famine in Vienna. Finally he was able to write to his old friend there, Wenckebach, the cardiologist who discovered the role of quinidine in heart disease, that food was coming, and it did come. He celebrated his seventieth birthday in good health, and received two large volumes of the contributions of admirers and former students. These, of course, were dwarfed by his own bibliography which had already run to 730 items! He died in December, 1919, leaving his unexcelled library to McGill University.

We come now to one of Osler's men at Johns Hopkins, Thomas McCrae, born in Guelph, Ontario in 1870. His father was a tough Scot, Colonel David McCrae, who, even at the age of seventy, raised and equipped a battery of horse artillery, which he took to World War I. After graduating in Arts and Medicine at the University of Toronto, Thomas McCrae joined Osler at Johns Hopkins in 1895 and became his shadow, literally. From his post as Associate Professor of Medicine McCrae went to the Chair of Medicine at Jefferson Medical College in Philadelphia and rose steadily in the ranks of consulting physicians to become President of the Association of American Physicians. He was married to Osler's niece Amy Gwyn.

In Britain McCrae was early recognized, becoming a Fellow of the Royal College of Physicians in 1908. His association with Osler at Hopkins was that of slave and scribe, writing verbatim notes on all the patients seen at ward rounds. Osler's *Principles and Practice of Medicine* owed much to McCrae, and the ninth edition was issued under both names. McCrae carried the great textbook through three further editions until his death in 1935.

However, McCrae's hand was even more prominent in the great seven volume system, *Modern Medicine, Its Theory and Practice*, issued in the years 1907–1910, and subsequently republished in second and third editions. McCrae

had most trouble with a contributor named Osler! He would cable to him at Oxford, where the tardy contributor would say to Lady Osler, that he would "wait for the second cable before beginning to write" the chapters. However, McCrae, strangely enough, was paid the compliment of his life by Lady Osler when she said, "Tom McCrae is the only man I'm afraid of." He made Osler's life easier by carrying much of the load of his wards and book revisions, in the Baltimore and Oxford periods.

Thomas McCrae's brother John, the "Soldier Poet" of "Flanders Fields," was two years younger. It is said that he qualified for a professional career, either in theology, medicine or the law, by memorizing the *Shorter Catechism* by the age of three. He graduated in Arts and Medicine at the University of Toronto in 1898 as gold medalist, having spent the previous summer at the Garrett Children's Hospital at Mt. Airy, Maryland. He served as a resident physician at Johns Hopkins Hospital in 1899 and then became Assistant Pathologist to the Montreal General Hospital, undoubtedly on Osler's recommendation. Within a year, however, he was on his way to the Boer War in South Africa, as an artillery officer. The vastness of the theatre in which this was fought becomes clear from his letters of that time. Returning with several decorations, he resumed his work as pathologist at the Montreal General Hospital and completed his revision of Adami's *Textbook of Pathology*. He took up his writing again, which had been one of his delights since his years in Arts at Toronto. At the Montreal General he personally wrote, in his firm, clear hand, all the autopsy reports.* He produced two or three short poems a year for the rest of his

* The volume for the year 1901 bears on one of its front pages the following inscription in McCrae's hand.

Jan 3/'02

"Here begynneth ye Booke of ye Deade, wherin is fayrely set foorth ye last state of four Hundred and seventeene persones, that have departed this lyfe, wherein be tabled diverse straunge and fearsome condicions that have ledde to ye same final ende: God have them of his grace."

life His pathology and his activity as an internist in Montreal came to an end when, in 1914, war came upon the world On May 27, 1915 he wrote from the Front

> "Day cloudy and chilly We wore our greatcoats most of the afternoon, and looked for bits of sunlight to get warm About two o'clock the heavy guns gave us a regular black-smithing' Every time we fired we drew a perfect hornet's nest about our heads While attending to a casualty a shell broke through both sides of the trench, front and back, about twelve feet away The zig zag of the trench was between it and us, and we escaped From my bunk the moon looks down at me, and the wind whistles along the trench like a corridor As the trenches run in all directions they catch the wind however it blows, so one is always sure of a good draught We have not had our clothes off since last Saturday, and there is no near prospect of getting them off"

He adds another entry

> And all the time the birds sing in the trees over our heads"

McCrae's great poem, 'In Flanders Fields," appeared in *Punch* in early 1915 and made him famous overnight His commanding General, E W B Morrison, has written this about the background

> "This poem was literally born of fire and blood during the hottest phase of the second battle of Ypres My head quarters were in a trench on the top of the bank of the Ypres Canal and John had his dressing station in a hole dug in front of the bank. During periods in the battle men who were shot actually rolled down the bank into his dressing station Along from us a few hundred yards were the headquarters of a regiment, and many times during the sixteen days of battle, he and I watched them burying the dead whenever there was a lull Thus the crosses, row on row We often heard in the mornings the larks

singing high in the air, between the crash of the shell and the reports of the guns in the battery just beside us he mentions having written the poem to pass away the time between the arrival of batches of wounded, and partly as an experiment with several kinds of poetic meter"

After fourteen months with a battery of frenetic British Columbians McCrae was made Chief of Medicine at the large Military Hospital at Boulogne In 1918 he was chosen to be "Consultant Physician to the British Army in the Field" but died of pneumonia at No 14 General Hospital after a short illness His best epitaph is to be found in one of his own compositions concerning the medical profession

"It will be in your power every day to store up for yourselves treasures that will come back to you in consciousness of duty well done, of kind acts performed, things that having given away freely, you yet possess"

Another pair of Scottish Canadian brothers in medicine, born in Ontario and educated in medicine at Johns Hopkins University, were William and John MacCallum Sons of a general practitioner in the countryside around Dunnville, both showed an early interest in their father's home laboratory William chose classics as his field when he entered the University of Toronto, but was advised by his father not to neglect the sciences His summers were spent in botanical pursuits, and in apprenticeship to the father In 1894, William applied to enter Johns Hopkins University's first class in medicine, with second year standing! This really put the new Faculty to the test, but finally it was agreed that this near classicist should be allowed to enrol He led his class on graduation in 1897! As an undergraduate he inoculated birds with malaria, and was the first to show the sexual cycle of the malarial parasite in the blood Sir Ronald Ross, the great researcher in this field, had misinterpreted the flagellated form and jokingly remarked, when told of this medical

student's discovery, "I have ever since felt disgraced as a man of science" After training in pathology with William Welch, MacCallum concentrated on the role of the parathyroid glands in tetany, and with his colleague Voegtlin described their function in regulating the level of calcium in the bloodstream

For nine years MacCallum served as Professor of Pathology at Columbia University, and in 1917 returned to Johns Hopkins University as successor to Welch The textbook which MacCallum wrote reflected his case method of teaching at Baltimore and became a landmark in pedagogy He did not subscribe to the school which sought, with two left hands, to teach students by making them feel ignorant or small He was a painstaking and sympathetic educator

He loved to travel, and one of his finest papers, *The School of Montpellier*, read to the Historical Club of Johns Hopkins University, records his pilgrimage to that oldest of French medical schools still functioning As a teacher he expected real work from his students, and to judge by the way in which they responded to the lists of essays, usually historical, which he said he would like to see written, his methods were successful

The younger brother, John Bruce MacCallum, was an amazing, meteoric student of medicine, who died of tuberculosis at the age of thirty In those "short years," as his biographer Archibald Malloch has termed them, MacCallum published twenty-seven original scientific papers, six of them before he graduated in medicine in 1900 He wrote and enjoyed poetry, music and the theatre provided him welcome relief from his ill health As an undergraduate at Toronto he published many poems, some of them revealing considerable depression Things may have been quite dull thereabouts, for had not that great University been established in troubled colonial times, as the correspondence with H M Government at Westminster says, "to combat the seditious influence of Harvard"?

J B MacCallum illustrated all his papers personally, beginning with one on *Fresh Water Cladocera* in 1895 While an undergraduate at Johns Hopkins he produced what is still regarded as a milestone in the study of the disposition of the muscle fibres in the walls of the heart Just for good measure MacCallum did all the proofreading for Professor Llewellys Barker's large book, *The Nervous System and Its Constituent Neurones* He was certainly one student able to measure up to the Johns Hopkins requirement in medical education, that of thinking for oneself He also knew what it was to teach well, and in the years after graduation he became a popular and revered teacher at Denver and at the University of California

Tuberculosis dogged his life, however, and we find him in Jamaica, sketching, and even working at malarial transmission by mosquitoes, and later at La Jolla, California, writing and sketching when he could no longer hope for recovery Among his unpublished works were found his poem, written under the shadow on his lung, one might say, entitled *Spirit of Death* It concludes in tones reminiscent of Marlowe

> Oh come, be swift and take me while I stand,
> My work still strong beneath a steady hand "

Osler called J B MacCallum "one of the most brilliant young men it has ever been my lot to teach '

And now, we turn back to Ontario for another of our Canadian physicians Frederick Banting was born at Alliston, Ontario, in 1891, the youngest of five children He spent much of his time on his father's farm observing the science and art of agriculture, not to mention the heartaches of it. Fred was not only a good observer, he could sketch to perfection what he saw In fact, he could not have been very old when he plunged into oil painting, something which he kept up all his life The vast Canadian countryside never had a better student He knew it to its shores on the Arctic,

the Atlantic, and the Pacific Books occupied much of his evenings, but athletics, as in Osler's case, took all the daylight hours Banting had the physical constitution of a horse, without question

Local accidents, and the death of one of his close school friends from diabetes, were among the factors which determined Banting upon the medical career, though his parents hoped he would choose the ministry He thought of being a medical missionary, but soon after entering medicine, and seeing the famous orthopedic surgeon Clarence Starr operating at the Sick Children's Hospital in Toronto, he gave up the idea of preparing for foreign service He was drawn to orthopedics as a specialty and it came to be part of his life Another interesting event in his student life was the prophecy made to his class, hopefully, by Professor A B MacCallum in physiology, that some member of that class might unlock the secrets of the magic islands of the pancreas It always pays to throw out these challenges to succeeding classes of students

When World War I commenced, it became harder and harder for the universities to retain their students The University of Toronto was no exception, and men flocked to the colours, waiting all night for recruiting centres to open Even in the far West, as President Wesbrook wrote to Osler at Oxford, one third of the students at McGill College, Vancouver, seemed to leave daily, so that by a mathematical progression there would soon cease to be a need for university presidents on this side of the Atlantic

Banting's class of 1917 was destined to graduate in December 1916, and he proceeded at once to Ramsgate in England to join Professor Starr at an orthopedic hospital Soon they crossed to France and there began Banting's hardest work His endurance was phenomenal, and his tough physique saw him through some terrible bouts of operating Typically, he would spot German medical officers among the prisoners taken, and would put them to work at once! Except for minor

injuries he kept going until the last six weeks of the war when a bursting shell severely damaged his right wrist He was ordered out of the line but contrived to stay for another seventeen hours Throughout his life Banting was always sympathetic to the fact that there had to be rules, but he was convinced that they did not apply to him For his devotion to duty he was awarded the Military Cross

Post graduate training in the United Kingdom was followed by another year with Professor Starr in Toronto Then he set out for London, Ontario, to establish a practice in orthopedic surgery He had the good fortune to find a bread-and-butter instructorship in physiology with Professor F R Miller, one of Sherrington's pupils, and with him began work on the functions of the cerebellum in relation to decerebrate rigidity—a subject very much to the fore today in connection with Parkinsonism As Banting struggled to give assigned lectures in physiology, only one lecture ahead of the class, he stumbled on the pancreatic paradox, wherein the digestive role of the major part of the pancreas was well understood, but not the function of the islet cells, which cells had been *discovered by the medical student Langerhans fifty years* previously As he passed the medical library at the University of Western Ontario, on his way home from his all too quiet consulting rooms, Banting picked up a recent issue of *Surgery, Gynecology and Obstetrics,* in which Dr Moses Barron, of the Department of Pathology at the University of Minnesota, had written a paper on the relationship of the islets of Langerhans to diabetes, especially insofar as stones in the pancreatic duct affected them The "review of the literature" given by Barron electrified Banting when he read it that night, and at 2 A M we find him jumping out of bed and scribbling in his notebook "Ligate pancreatic duct of dogs Wait six or eight weeks Remove residue and extract"

He confronted Miller next morning with a plan of campaign, and Miller very wisely suggested that Banting discuss it with an expert in the field of carbohydrate metabolism,

Professor J. J. R. Macleod, of the Department of Physiology at Toronto. It required three visits by Banting to convince Macleod that it was worth authorizing ten dogs and eight weeks of laboratory time for this determined orthopedic surgeon, who looked strong enough to wring the secrets of the islet cells out of them by brute force if nothing else. Macleod finally said that as he would be away in Scotland for the summer, Banting could have space, dogs, and, most important to him, the services of an able graduate student in physiology, Charles Best. In giving up his summer earnings through playing baseball, Best made a sacrifice which only an old outfielder like Harvey Cushing could understand. Best had seen an aunt in Maine dying of diabetes, in his own household, and needed no prompting to take up the challenge. After all, Banting had only been a captain in the war, while Best had been one of that charmed company that has run all wars since time began, the sergeants.

On May 21, 1921, this pair began a period of several months' slavery in the heat of Toronto's summer, surrounded by the furore of barking dogs, and knowing little sleep. By December of that year they were able to report before a meeting of the American Physiological Society at Yale University that they had succeeded in isolating the active principle of the islet cells of the pancreas, and with this had saved the lives of a series of dogs made diabetic through removal of the pancreas. The ability of "insulin," as they called the potent hormone, to lower the blood sugar of animals, was described to the meeting in New Haven in the most painfully halting manner by Banting. Professor Macleod, long dubious about the whole affair, now found a stipend of $60 per month for Banting, and added Collip and Noble to the Toronto team. Collip's work in recovering insulin in pure form from the extract was quickly accomplished and made it safe to treat patients, who in hundreds, began to haunt Banting's doorstep. Finally, the practical and lovable Velyien Henderson, Professor of Pharmacology, found a

salary of $2,200 a year from his own funds for Banting's support Children brought to Toronto in the last stages of diabetes were snatched from death by injections of the new substance, and the world began to realize that a farmer's soldier son had changed the world for untold millions Banting later used to marvel at the application of insulin shock therapy to mental patients as one of those unpredicted by-products of his discovery

Business men set up a foundation which still continues to aid pioneer research in Canada in Banting's name Sir William Mulock, who headed this group for some time, remarked of Banting, "He has no money sense at all You don't have to pick his pockets, he would freely give you everything in them" This was all too true, and Banting used to find himself at the end of a year, having to borrow the money with which to pay his income tax, that newly invented plague He was given the Nobel Prize in 1923 Most unfortunately only Macleod's name was coupled with Banting's in the prize, but Banting immediately shared his fraction equally with Best, and Macleod did with Collip

Amidst all the shouting, Banting kept plugging away at his concept of research He told audiences, "It is not within the power of the properly constructed human mind to be satisfied" Speaking to the Canadian Medical Association meeting in Victoria, B C, and to the many American colleagues who were present, he said

> "Medical research is the most truly international commodity we possess It knows no protective tariff, no embargo, no boundary line to prevent its free dissemination for the good of all At present it is the common language and common spirit among the nations"

He was keen on medical students working in research laboratories, and the group of these which he trained in his Institute in Toronto became the nucleus of Canada's medical research effort in World War II Banting had travelled extensively in Europe during the Thirties, and returned home

in 1938 to develop aviation medical research on a wide scale He built a decompression chamber for dogs at the Banting Institute, but he insisted on getting into it and "ascending' to unheard of heights, just to be sure it was safe for the dogs On these runs he trusted his life to Dr Edgar Black, the toughest little package of adrenaline which Banting had to handle in the war Of reddish complexion and of Baptist background, the uncompromising Black was a match for Banting once he had him locked in 'the tank" When Banting shouted through the glass porthole, 'Take me up further, at once," Black replied, 'You're coming down, Sir," to which Banting retorted, 'I ll fire you" Black's answer was always the same, "You've had enough You're perseverating You threatened the same thing last week You're coming down"

Between the wards Banting had stimulated all manner of studies, on cancer, silicosis, the "royal jelly" upon which queen bees feed, and the physiology of drowning With the war he started programmes in the study of gravity and black-out in aircraft, motion sickness, decompression sickness and anoxia His men took on this onerous research in all three of the armed forces, and they made real contributions to the store of Allied knowledge Banting was killed in a plane crash in Newfoundland, on a mission to Great Britain, in 1941

One of Banting's close associates in war time medical research was a naturalized Canadian, Wilder Penfield, who has been for twenty five years Director of the Montreal Neurological Institute Born in Spokane, Washington, in 1891, the son of a surgeon, he was educated in Wisconsin, and at Princeton University where he took an active part in the Woodrow Wilson for President campaign After a distinguished academic and athletic career there he went up to Merton College as a Rhodes Scholar This is remarkable, for the Founder had expressly forbidden the enrollment of "purely medical students" He was a wise man, and must have known the cost of repairs to buildings thus inhabited Penfield, however, was no routine medical student He had a

gift for languages and history, as his subsequent career has proven No Rhodes Scholar going up in 1913 could ask for anything more than he found a world still at peace, and two great teachers, Sir William Osler the Regius Professor of Medicine, and Charles Sherrington who had just arrived from Liverpool to become Wayneflete Professor of Physiology There began Penfield's apprenticeship in the fields of pathology and physiology, to which he has contributed so much in the realm of the nervous system

Penfield's association with Osler and Lady Osler was very close, for he was blown up on the Sussex' while crossing the Channel with other Americans, on his way to serve at the Front before the United States became officially involved Osler learned that his Rhodes Scholar friend had suffered a broken leg as he landed back on the deck of the foreward half of the ship, the only part to remain afloat He was nursed back to health at 13 Norham Gardens, and there developed a life long reverence for William Osler, the world of history and of books It is little wonder that he created the Osler Lectureship at McGill as a memorial to him

After graduation at Johns Hopkins Medical School, where he did undergraduate research on the treatment of haemorrhage by intravenous blood substitutes, Penfield returned to France and then to London for post graduate work with Gordon Holmes and Godwin Greenfield, the sages of Queen Square, the home of British neurology His dynamic wife and two children lived at Oxford, awaiting his return by bicycle each week end Then, from 1921 to 1928 he served as Neurosurgeon to the Presbyterian Hospital in New York, with a six months' break to study in Spain with Ramón y Cajal and Rio-Hortega the microscopic structure of brain tumors From this grew his three volume classic *The Cytology and Cellular Pathology of the Nervous System* No work has ever equalled this for a comprehensive treatment of a vast field which, until then, had been in the greatest need of classification

In 1928 the professor of surgery at McGill University, the versatile Edward Archibald, father of thoracoplasty, and an accomplished neurosurgeon to boot, persuaded Penfield to come to McGill with the prospect of setting up a neurological institute. After the First World War there had been great pressure in the United States to build such a structure, and men like Salmon spent years in trying to bring it about. Now, with Rockefeller backing, there seemed to be an opportunity at Montreal. Planning proceeded throughout the depression years, and in September, 1934 a beautifully integrated institute for teaching, research and treatment was opened. It has since proved to be a medical Mecca, and men from every corner of the globe have flocked there to learn Penfield's methods of studying epilepsy, and of operating on selected cases. Physiological observations, begun at Oxford, have been extended to the patients under Penfield's care, with the greatest benefit to the patients themselves. Some of those whom Wilfred Trotter accused of having "a beefy fist and a mutton mind" have referred to these neurosurgical interventions as "experiments." This is a woeful distortion of the truth. Each craniotomy is performed and each electrical stimulation of the cortex is carried out for only one reason, to help that particular patient, as I know from long hours spent at the operating table there. Thus, the need for therapy has provided a great research opportunity, in an organ encased in bone and stoutly shielded from the hand of the enquirer. Cortical localization, the function of the temporal lobes, the end results of birth injuries, and a host of other important matters have been illuminated by Penfield's unflagging work, sometimes against the unremitting criticism of people fit only for Osler's appellation "They don't know that they don't know." Osler used to call these types "the men who jeered at Harvey, scoffed at Pasteur and scorned Lister—the carpenters in surgery and the pill mongers in medicine, without vision beyond the bench or the counter."

Penfield's war time missions took him twice to Soviet Rus-

sia, and through most of the Middle East and China His historical novel, *No Other Gods*, has been followed by *The Torch*, a study of the life of Hippocrates, conducted in Greece by Canada's outstanding medical ambassador Sherrington would have been delighted, had he been alive, to see his own Order of Merit bestowed upon his pupil Penfield who combines the best of American, Canadian, and British traditions

William Henry Drummond, the poet of the 'patois," beloved alike by English and French speaking Canadian, has been considered in Chapter X Robert Tait McKenzie, the physician sculptor, was born in Almonte, Ontario in 1867, the year of Canada's emergence as a self governing Dominion After graduating in medicine at McGill University, interning, serving as ship's surgeon, and teaching anatomy and physical education at McGill for some years, McKenzie joined the Faculty of the University of Pennsylvania as Professor of Physical Education in 1904, and served in that capacity for twenty seven years Even in his Montreal days McKenzie was fond of portraying his colleagues in bronze, including Drummond Gradually the hobby became a life's work, and by 1912 McKenzie had done so much to portray athletes in characteristic poses that the King of Sweden decorated him at the Olympic Games in 1912

In World War I, McKenzie made a name for the Canadians interested in the field of rehabilitation As the *Lancet* said

> "In England the principle of simultaneous treatment and training was not at first accepted, but later was amply justified Tait McKenzie's life work served both the education of the healthy and the re-education of the injured To these tasks he brought imagination"

Any who have seen his Scottish War Memorial in Edinburgh, or the Canadian monument to General Wolfe at Greenwich Royal Park, will agree that he brought true imagination to his artistic tasks also In the design of medals and memorial plaques, including those of Osler, Weir Mitch-

ell, Sir Robert Jones his wartime orthopedic teacher, and Sir Ronald Ross of malaria fame, and many more, McKenzie caught the spirit of his subject most wonderfully. He would not cast the Osler plaque until Dr Cushing had inspected it and made certain suggestions, such as altering the chin and taking Osler's hand out of his pocket!

One of Canada's most distinguished but least known physician educators was Frank Fairchild Wesbrook (1868–1918) Though born in Ontario, his student life was associated with Winnipeg where he graduated with his M A and M D degrees His father was Mayor of the city. His later life brought together experience in the United Kingdom, the United States and finally British Columbia where he was *the first President of its University*

From internship to university presidency was a twenty-five year period into which were compressed a brief service as railroad surgeon at Banff in the Canadian Rockies, a summer's work at McGill, a course at the Rotunda in Dublin where he caught the fire of the dedicated researcher, E A Hawkin, the bacteriologist whose Cambridge origins undoubtedly paved the way for Wesbrook who entered Gonville and Caius College there as John Lucas Walker Fellow, and remained immersed in that stimulating atmosphere for three years It was in this setting that he came to know Charles Scott Sherrington, who was to be his constant friend and adviser until Wesbrook's death at the age of fifty Parenthetically, Sherrington was as athletically inclined as Wesbrook, the track and field man and sculler, but outlived him by forty five years

Of these Cambridges days Wesbrook later wrote to Sherrington, "I can never forget your kindness to me when, through the departure of Kanthack, Hankin and Adami from Cambridge, I, a mere youngling, was left as the exponent of Bacteriology You kept me from rocks many times" After study in Marburg, Wesbrook returned to Canada to be Professor of Pathology at the University of Manitoba. Soon,

however, he was made Professor of Pathology, Bacteriology and Public Health at the University of Minnesota Eleven years later, at the age of thirty nine, he was elevated to the deanship of the Faculty of Medicine, and became President of the American Public Health Association One of his clinical colleagues at Minnesota has written, "He was the most attractive personality I have ever met."

In 1913 Wesbrook was installed as the first President of the University of British Columbia at Vancouver From an early McGill University two-year college and several denominational colleges, Wesbrook was to forge a new university His patron throughout the founding years was the general practitioner and Osler disciple, Dr Henry Esson Young, who had become Minister of Education and Health in the Provincial Government. As the Great War unfolded it became clear to Wesbrook that his dream of a full fledged university would have to wait. He wrote to Sherrington on June 1, 1915, "We are, like others, in the anomalous position of getting ready to start work next autumn, when perhaps our duty, both in regard to students and staff, may lie in Europe rather than in British Columbia"

To the people of the province Wesbrook explained

> "Although we cannot begin our University work with the full organization and equipment for the training of specialists in all lines, we have the opportunity of learning the fundamental lesson of service to humanity To meet in full our obligations may ours be a Provincial University without provincialism May our sympathies be so broadened and our service so extended to all the people of the Province that we may indeed be the people's University, whose motto is '*tuum est*' The people's University must meet *all* the needs of *all* the people We must therefore proceed with care to the erection of those workshops where we may design and fashion the tools needed in the building of a nation and from which we can survey and lay out paths of enlightenment, tunnel the mountains of ignorance and bridge the chasms of incompetence"

Though head of the Officers' Training Corps, leader in the promotion of a Patriotic Fund, and an outstanding figure in the public life of his adopted province, Wesbrook yearned to get into the war effort personally He wrote Sherrington on January 11, 1916

> "We have started with three hundred and seventy eight students enrolled, and fifty six at the front, seventeen have already enlisted this year, and I have recommended eight more for British commissions I have been in com munication with Sir William Osler and Adami in the hope that I may be of some service in sanitary matters If you hear of anything which might promise a greater pos sibility for me to be of use there than here please let me know my preference would of course, be on the com batant side *I feel as if I had no business to be here at all*"

Once his Board of Governors had told him that his duty lay at home, in building a university to which the men fighting overseas might one day return with pride, Wesbrook threw himself into his duties as President, and took on the Professorship of Bacteriology also He was the province's public orator' in many ways, and the collective conscience of the widely scattered inhabitants of the Pacific coast To meet the worsening financial situation in a wartime economy he had to prepare as many as six separate budgets in one year He wore himself out in trying to move his new uni versity from the downtown site of McGill College to the promised land of a 500 acre campus on Point Grey, com manding one of the world s great marine views, looking out over the Pacific Just three weeks before the Armistice was signed, Wesbrook died of hypertensive cardiovascular disease His hopes of bringing William Bragg the physicist, and William McDougall the psychologist, to Vancouver remained unfulfilled Seven short years later his university opened its fine new buildings at Point Grey and began to graduate scholars within the ensuing ten years whose even-

tual productivity, in the sciences, led all of Canada and was fourth in North America Well might succeeding students sing of Wesbrook that "his soul goes marching on"

It would be impossible to contemplate a survey of Canadian physicians without referring to one, recently departed from the scene, Jonathan Campbell Meakins, known as well in the United Kingdom and in the United States as in his native Canada Born at Hamilton, Ontario in 1882, he studied medicine at McGill University and upon graduation in 1904 took up residency training in the Royal Victoria Hospital in Montreal These were difficult years for him as he suffered from a serious speech impediment, as he used to tell me when I was his patient for long periods at a time While his brother was the idol of Broadway, dancing in *The Merry Widow*, Jonathan was labouring to overcome his terrible stammer By sacrificing a year to remedy this handicap, at the suggestion of his teacher Dr C F Martin, Meakins became almost as fluent a speaker as he was a writer

He used to say that as a result of the self confidence gained in the process, he astounded the trustees of the Presbyterian Hospital in New York by telling them during an interview that he would consider leaving Johns Hopkins to become their resident pathologist only if they doubled their proposed salary He received the appointment from the slightly stunned board, and it was while at the Presbyterian that he was joined by Cecil and Dochez in a little journal reviewing club The result was to be the writing of an authoritative textbook by each man a generation later

Meakins went to the first World War in 1914 and served with distinction in heart hospitals, general hospitals and in the pulmonary laboratory investigating gas poisoning As a pupil of Sir Thomas Lewis at University College, London, he laid the foundation for his outstanding career in therapeutics at Edinburgh and internal medicine at McGill. As Dean of Medicine at McGill, and eventually as Director General of Medical Services for Canada's Army Medical Corps, he

earned the respect of two generations of Canadians and Americans He was equally at home south of the border, and served with distinction as President of the American College of Physicians and Editor-in Chief of the *American Heart Journal*

Not only as a writer of textbooks but also as an expositor of things to come, Jonathan Meakins attained an international reputation As an educator he was far ahead of his time and wished to offer an honours M D degree to those who had a first class record and who submitted an acceptable graduation thesis, a proposition likely to be supported in the future by many enterprising schools

In the provision of pre paid medical care, Meakins was thought by some of his more stuffy colleagues to have highly heretical views He used to smile at their castigation of his speeches on this subject, and to congratulate himself on having such pedestrian opponents

It is satisfying to relate that Meakins was one of the fathers of the Canadian Mental Health Association over the years, and planned the development of the Allan Memorial Institute of Psychiatry at McGill Despite the fact that he carried on his shoulders the cares of almost every lay organization in the medical field in Montreal, he lived seventy seven useful years, his majestic figure unbowed by personal tragedies which would have unhinged most of us

Two other outstanding Canadians I would like to mention, in conclusion, are Maude Abbott and Norman Bethune, both raised in a manse, and both crusaders in different theatres of war Maude Abbott was a protégé of Osler, and thanks to his encouragement made congenital heart disease her life study Her way was hard, and yet she was the soul of solicitude and kindness Because women were not admitted to McGill's Faculty of Medicine, she took her degree through Bishop's University which for some years had its medical establishment at the Montreal General Hospital The superintendent of the Hospital so hated the thought of women

students that he went to the wards after hours and personally destroyed the case histories written up by Miss Abbott He eventually met his Waterloo at the hands of the Professor of Surgery, and thereafter Maude Seymour Abbott's student work became recognized as the best ever seen in that Hospital

Dr Abbott had developed the art of putting students to work to a fine degree when I first met her in 1934, and I soon found myself heavily laden with tasks as I set off for Oxford in 1935 My duty, as Dr Abbott conceived it, was to make a complete alphabetical index of everything which Osler ever wrote and everything written about him! As I took up rooms in Oxford's Broad Street above a well known tea room I appropriated twenty six cream pitchers and began to cut up two copies of the Abbott version of Osler s bibliography It was the best education I ever had, and I soon found myself going around to the Bodleian Library and its branches in search of Osler's papers on hundreds of fascinating subjects I had finished the cutting up process when a maid on the premises decided the cream jugs were needed below, and I was mortified to find my work thoroughly shuffled, and lying in the waste basket Thereupon I decided to paste the narrow paper strips on a "master roll" of wall paper, and before anything could befall it, I sent it by the mail to the overjoyed Dr Abbott in Montreal. I found on returning to Canada in 1938 that many of my classmates had had similar experiences, and though we all pretended to feel put upon, we knew in our hearts that we had each learned something invaluable

Maude Abbott's atlas on malformations of the heart is, of course, a volume known internationally She was a forerunner in the diagnostic field concerning "blue babies" and would today be happy to see the inroads which surgeons have made in the field of heart disease As an historian of medicine, and as a promoter of teaching through medical museums, Dr Abbott became an international authority Her

rotund figure, according to her jovial colleague, Dr W W Francis, could hardly be missed at medical meetings When she was caught between two trams cars in Montreal and rotated seven and a half times round before she could escape, the same puckish Francis observed at her bedside, "No ribs broken, *Maudie Proves what I've always said—you're made* of rubber, not blubber' Though buffetted by the conventional male all her life, Maude Abbott made a contribution to medicine equalled by few men

Norman Bethune was an enquiring student of medicine who was struck down with tuberculosis soon after graduation at McGill University His biography *The Scalpel, The Sword* has chronicled his amazing life in the Spanish and Chinese civil wars so well that no extended reference is needed here The methods which he introduced into chest surgery were later to become standard procedures His contribution to Canadian painting was limited but highly original His pioneer work in Spain on blood transfusion services in the heat of war, was a major contribution to modern medical science He died of an infected wound while serving in China

Thus, this chapter on some Canadian physicians must be brought to a close Many of those mentioned have made their contributions outside of their homeland where opportunity for medical research is still severely limited, in comparison with that in the United States and the United Kingdom Those discussed in this chapter have become world citizens of stature and a credit to the universities which trained them Perhaps by describing their lives to an international audience it may be possible to reach Canadians who, in general, have only a fragmentary picture of their own rich inheritance and their country's true destiny

Chapter VIII

Contributions to Medical Science by General Practitioners

It MAY seem incredible to many admirers of the family physician of yesterday that he was often more than a practitioner, he might also be an inventor or discoverer

The field of bacteriology and infection boasts contributions by two general practitioners which alone would make this subject well worth discussing, those of Edward Jenner (1749–1823) and Robert Koch (1843–1910) Their lives span more than a century and a half of the most exciting period in the study of infectious diseases Strangely, protection from that terror of all civilizations—smallpox—came a century *before* the isolation and demonstration under the microscope of the first microorganism causing a specific disease, anthrax

Jenner might well be the patron saint of all family physicians today for he typifies the country scientist interested in agriculture, birds, plants and flowers, the weather, and especially people He had the good fortune to inhabit one of England's most delightful countries—Gloucestershire—and to practise in the village of Berkeley, just as tranquil today, with its remarkable castle, horses, hounds and geese, as ever it was

Jenner began the practice of medicine in Berkeley at the age of 24, surrounded by his friends and those of his father, the Vicar This move into general practice was by choice, and followed the rejection of Captain Cook's offer to take Jenner on his second expedition as naturalist, surely an inviting prospect for a young doctor with Jenner's native cu-

riosity It is clear that Jenner in his practice continued to pursue an undergraduate interest in cardiology, and we find him in a few years writing a paper which was to become a milestone, *Remarks on a Disease of the Heart Following Acute Rheumatism* This paper was twenty years ahead of the generally recognized classics in this field Other interests occupied his mind also, such as aeronautics In the same year as Montgolfier in France ascended to 1,000 feet in a balloon, Jenner constructed a hydrogen balloon in the great hall of Berkeley Castle, and cast it adrift over the Vale It travelled for miles, and, luckily for Jenner, was returned to him intact, for another charge of hydrogen It will be recalled that in France the peasants had set upon the early balloons as they descended, and tore them to pieces with pitchforks, thinking them possessed

At the age of forty two Jenner gave us our first description of the *allergic process known as* "anaphylaxis," or hyper-*sensitivity to a foreign protein injected some time* after the administration of a minute amount of it He was determined to find out how much immunity to smallpox his patient Mary Barge had acquired as the result of an attack of this disease He therefore injected under her skin a small amount of living smallpox virus, and was astonished at the body's reaction He wrote

> "It is remarkable that variolous matter when the system is disposed to reject it should excite inflammation more speedily than when it produces the smallpox It seems as if a change which endures throughout life, had been *produced in the action or disposition to action*, in the vessels of the skin Whether this change has been effected by the smallpox or the cowpox, the disposition to sudden cuticular inflammation is the same on application of variolous matter"

He discussed the likelihood of a sympathy between the constitution and the skin, in all probability through the brain and nervous system"

Then, after twenty three years of gathering evidence on reported *protection against* smallpox by prior exposure to cowpox, Jenner took the plunge His own words best give us the story

> "I selected a healthy boy (James Phipps) about eight years old, for the purpose of inoculation for the cow pox The *matter was taken from a sore on the hand of a dairy* maid (Sarah Nelmes) who was infected by her master s cows, and it was inserted on the 14th day of May, 1796, *into the arm of the* boy by means of two superficial inci sions, barely penetrating the cutis, each about half an inch long
>
> "On the seventh day he complained of uneasiness in the axilla, and on the ninth day he became a little chilly, lost his appetite, and had a slight headache During the whole of this day he was perceptibly indisposed, and spent the night with some degree of restlessness, but on the day following he was perfectly well. In order to ascertain whether the boy, after feeling so slight an affection of the system from the cowpox virus, was secure from contagion of the smallpox, he was inoculated on the first of July following, with variolous matter, immediately taken from a pustule Several slight punctures and incisions were made *on both his arms, and the matter was carefully inserted,* but no disease followed Several months afterward he was again inoculated with variolous matter, but no sensible effect was produced "

Over the ensuing three years the busy country practitioner found time to bring together his little publication *An Inquiry*, in which he gave to the world his description of twenty three successful vaccinations against smallpox. The utter simplicity and directness of Jenner's reporting is striking He was obviously not subsidized by some manufacturer, there was no fanfare, television preview, nor press conference heralding this, one of the greatest "firsts" of all time In fact, it took fifteen years for Oxford University, a few miles away, to confer an honorary degree But I am doubly glad

that they did so, when I read that the College of Physicians in London refused to admit Jenner except by examination General practitioners, it would seem, may save the world, but may not enter the kingdom of specialists Some day I hope that no doctor may call himself a specialist until he has had one year's apprenticeship under a supervising country practitioner

One surgeon, Mr Cline of St Thomas's Hospital, had his imagination fired by Jenner's discovery He wrote Jenner that he could expect an income of the fantastic amount of £10,000 per year if he would practise in London Jenner's reply should be on the walls of every general practitioner's office today

> Shall I, who even in the morning of my days sought the lowly and sequestered paths of life, the valley, and not the mountain, shall I now my evening is fast approaching, hold myself up as an object for fortune and for fame? Admitting it as a certainty that I obtain both, what stock should I add to my little fund of happiness? My fortune, with what flows in from my profession is sufficient to gratify my wishes, indeed, so limited is my ambition and that of my nearest connexions, that were I precluded from further practice, I should be enabled to obtain all that I want And as for fame, what is it? a gilded butt, forever pierced with the arrows of malignancy"

One is reminded of the obituary notice of Helmholtz which appeared in London's effervescent *Punch*

> "When Emperors, Kings, Pretenders, shadows all,
> Leave not a dust trace on our whirling ball
> Thy work, O grave eye Searcher, shall endure,
> Unmarred by faction, from low passion pure"

A century after Jenner's great observations, another general practitioner, Robert Koch, working in a country practice in Wollstein, Germany, discovered the spore forming anthrax bacillus and proved, for the first time in history, that a

specific causal organism produced a specific disease. The cost of anthrax infections to this farming community had been so high that any general practitioner would have felt some obligation to investigate its origin. In Robert Koch, the people of Wollstein were doubly blessed. Their physician had won a prize essay contest in his third year of medical school on a neuroanatomical subject, and for his graduation dissertation he had performed many experiments, some on himself, on the excretion of succinic acid in animals fed upon nothing but fat and meat. In other words he knew how to make orderly observations and how to ask Mother Nature the right questions. As a child he had often accompanied his engineer father on botanizing and mineralizing expeditions. The ever-helpful Professor Krause at Gottingen University, who did so much for Ramón y Cajal, made Koch his undergraduate assistant in the Pathological Museum. Thus, in Pasteur's phrase, we find "fortune favoring the prepared mind." But, again, as in Jenner's case, Koch *cared* what happened to his farmers, their families and their flocks, and because he cared sufficiently he was determined to find out what caused the deadly disease, anthrax. This is but another example of the truth of the late Alan Gregg's view that mistakes in medicine are not made by men who do not *know*, but by men who do not *care*. Koch *cared*, and as a result the little world of Wollstein was changed, and soon a bigger world still was changed.

Koch's recognition began when the friendly botanist Ferdinand Cohn of Breslau listened to the story of the isolation of the bacillus, its transmission through several generations of mice, and even its growth in artificial media outside the body. Among the first to see Koch's demonstrations in Breslau and to support his views was William Welch, the famous pathologist of Johns Hopkins Hospital. The discovery of the tubercle bacillus, and the statement of his four postulates, brought Koch to the very zenith of his career. It was but a logical continuation of his work carried on for so

long behind a little screen in the examining room in his rural practice in Wollstein

The most important drug in the history of cardiology, digitalis, was introduced by the general practitioner William Withering in 1785 As a medical student in Edinburgh, he had read two papers on dropsy to the Royal Medical Society, *the oldest student society in Britain After returning to the* west country to practise, he began to study botany in earnest, and his activities as a naturalist remind one of other Shropshire men such as the Darwins, Beddoes, and Hickman of anaesthesia fame In his *Account of the Foxglove*, a little volume which was to change the lives of all sufferers from heart disease, he wrote

> In the year 1775, my opinion was asked concerning a family receipt for the cure of dropsy I was told that it had long been kept a secret by an old woman in Shropshire, who had sometimes made cures after the more regular practitioners had failed I was informed also, that the effects produced were violent vomiting and purging, for the diuretic effects seemed to have been overlooked This medicine was composed of twenty or more different herbs, but it was not very difficult for one conversant in these subjects to perceive, that the active herb could be no other than Foxglove"

Withering saw between 2,000 and 3,000 sick poor per year in special free clinics which he set up, and for them he did his best to work out a safe and yet useful dosage of a decoction of Foxglove leaves He knew that the active principle varied in strength depending on the time of year the leaves were removed from the plant He said

> I soon found the Foxglove to be a very powerful diuretic, but then and for a considerable time afterwards, I gave it in doses much too large, and urged its continuance too long I had not, however, yet introduced it into the more regular mode of prescription, but a circumstance happened which accelerated that event My truly

valuable and respected friend, Dr Ash, informed me that Dr Cawley, then principal of Brazen Nose College, Oxford, had been cured of a hydrops Pectoris, by an empirical exhibition of the root of the Foxglove, after some of the first physicians of the age had declared they could do no more for him I was now determined to pursue my former ideas more vigorously than before"

The most interesting thing about Withering was that he, like all good physicians, was a good listener, and he took seriously what his patients told him Thus, he learned of a Foxglove remedy for dropsy in the neighborhood of Warwick, and another in west Yorkshire He wrote

In confirmation of this, I recollect about two years ago being desired to visit a travelling Yorkshire tradesman I found him incessantly vomiting, his vision indistinct, his pulse forty in a minute Upon enquiry it came out that his wife had stewed a large handful of green Foxglove leaves in a pint of water, and given him the liquor, which he drank at one draught, in order to cure him of an asthmatic affection This good woman knew the medicine of her country, but not the dose of it, for her husband narrowly escaped with his life"

Withering probably felt that his labours were rewarded when, in 1783, his Foxglove was placed in the Pharmacopoeia of his old Medical School in Edinburgh

The middle of the nineteenth century saw the action of digitalis being made the subject of the Corvisart Prize Essay in the Faculty of Medicine in Paris The winner in 1850 was Paul-Louis Duroziez This was the beginning of a long and productive career in cardiology by a general practitioner who never held a teaching or attending post at any of the university hospitals in Paris At the age of thirty-five he published his first classic, *The Double Intermittent Murmur over the Femoral Arteries as a Sign of Aortic Insufficiency* This murmur is still known as Duroziez's sign In the same

year he published a paper on the pure type of mitral stenosis, thereafter known as *Duroziez's Disease*. While serving as a school physician in 1891 he was awarded prizes for his book *Traité Clinique des Maladies du Coeur*, by the Academy of Medicine and the Institute of France. Perhaps because he was a general practitioner he retained his lively sense of humor, and loved to tell his confrères that the heart had a male half, the left ventricle, which was "calm, regular and stable." The right half was the female half, "nervous, impressionable and often disordered." It was said of Duroziez that "Bruits were to him sweet music; he listened to them in the chest, surprised them in the back, pursued them into the neck and even into the thigh."

Coming now to more modern times, we must consider the amazing life of Sir James Mackenzie, born in the year 1853 in the parish of Scone, the ancient site of the crowning of Scottish kings. Mackenzie always said he was regarded as a "dunce" at school in Perth because he was not concerned to memorize things. He wrote of these days—"The subjects in which I did well were those in which my understanding, rather than my memory, was called into play." He left school at the age of fifteen, a dispirited and unhappy lad, and for five long years served an apprenticeship with a local pharmacist. In this situation, the only scientific one open to him in Perth, he saw the country practitioners who came into the town to have their remedies compounded. By the age of twenty-two, Mackenzie determined upon a medical career, and turned down an offer of a lucrative partnership in the pharmacy.

Going up to Edinburgh with his brother, he lived literally on "oatmeal porridge and the shorter catechism." His preclinical work was drudgery of the worst sort, and the teaching just as uninspiring as when Charles Darwin had tried medicine there, only to give it up for theology at Cambridge. Mackenzie was, in later years, so articulate that I think he should tell his own story. He wrote:

"The outcome of the teaching of today is to hail the student with superior powers of memorizing as the brilliant student, and the one with the great future (Obviously he had not heard Henry Angus' caustic definition of a Rhodes Scholar as a man with a brilliant future behind him) The consequence is that his path from the outset is made easy for him Bursaries and scholarships fall to his share, and before he has acquired any experience, he is appointed to a teaching post In the absence of any knowledge acquired from the results of his own observations, he is forced to teach that which he was himself taught, and as he cannot discriminate between truth and superstition, he hands both on to his students As years pass he comes to believe what he has taught is true and may even grow impervious to new ideas which are contrary to the beliefs he has been expounding"

He added

" during my college career I felt a longing to devote myself to some of the branches of medicine concerned in research, but my very moderate attainments precluded me from obtaining any of the coveted posts about the University, and I quite clearly recognized that I was only suited for what is considered the lowest place in the medical profession"

Nevertheless, Mackenzie hit his stride when he reached the bedside years of the medical course, and graduated with three medals On the advice of his instructor in anatomy, Dr John Brown, Mackenzie sought a residency in Edinburgh's Royal Infirmary, and was surprised to be accepted for the November 1878 group coming on service He filled in the intervening months as a *locum tenens* in a colliery practice in County Durham There he was initiated into the worst features of "club" or "lodge" medicine, some of which unfortunately persist in Britain today Poor Mackenzie was thunder-struck by what he saw—the most pernicious form

of 'bottle medicine," and, as a well trained pharmacist, he knew the swindle that was being practised on the miners who placed great store by what they regarded as "powerful" mixtures, which were nothing but burnt sugar and water with a little ginger flavouring

The same good Dr John Brown, a year later, persuaded Mackenzie to join him and a partner in a large Lancashire type of practice in the town of Burnley, soon to become the shrine of all cardiologists He found his Edinburgh hospital training quite unrelated to the patients he now saw for the first time He ransacked his student notes and texts, without success, and even bought an encyclopaedia, rivalling in size, though not in content, *Dr Eliot's Bookshelf*. He wrote prophetically

> For some years I thought that my inability to diagnose my patients' complaints was due to personal defects, but gradually, through consultations and in other ways, I came to recognize that the kind of information I wanted did not exist"

He continued.

> 'About 1883 or 1884 I resolved to begin a series of careful observations entirely for my own improvement, never dreaming of research, for I was under the prevalent belief that medical research could only be undertaken in a lab oratory or, at least, in an hospital with all the appurtenances I merely sought to find out something about the nature of my patients' complaints I had recognized that when the patients had some physical sign, and when disease had made considerable ravages in the body, a mod erately accurate diagnosis could be made, but in the vast majority of my patients there was no physical sign, or if there was a physical sign, I was not sure of its relationship to the patient's ill health I had thus placed before me two definite objects, at which to aim (1) understand-

ing of the mechanism of symptoms, and (2) understanding of their prognostic significance"

The loss of a patient in labour, from heart disease, so disturbed Mackenzie that he vowed he would find out the causes of the major heart ailments, and he did, as all the world knows today Starting from an analysis of the pulse, in a variety of normal and pathological conditions, he progressed to the ink polygraph and electrocardiography, but always with the clinical notes beside him He followed his patients over the years and correlated autopsy findings with clinical symptoms in a masterly way Most of all, he proved for all with eyes to see, that clincial science was a field crying out to be studied, and he was not to be deterred by people studying frogs, and by pedants working off their obsessive compulsive neuroses by classifying every disease within sight, especially those which they did not understand

When Osler went from Johns Hopkins to become Regius Professor at Oxford in 1905, he lost no time in visiting Mackenzie at Burnley, as Cushing records, with A G Gibson from the Radcliffe Infirmary A year later Sir Arthur Hurst returned from Germany to blast his British colleagues with the startling information that only Mackenzie was known on the Continent Thus, did a general practitioner, working quietly but purposefully for thirty years in a Lancashire mill town, with the people that he loved, build the framework on which all scientific cardiology rests today

Endocrinology has had its contributors, too, from the field of general practice The name of Kussmaul is always associated with diabetes because of his description of the "air hunger" manifested by the diabetic in coma The life of Kussmaul as a rural physician is not well known, however, and I want to discuss it briefly, because his powers of clinical observation, developed in a practice near the western borders of Germany in the middle of the last century, were both remarkable and productive

Adolph Kussmaul was born into a long line of doctors who had served the Soellingen district well. Indifferent schooling led Adolph to accompany his father on consultations out into the country, where he learned a great deal about Nature. At the age of 18 he entered the University of Heidelberg, in the toughest of the duelling days. His medical career there was notable for the length of time which he was privileged to spend with Naegele in obstetrics, and for the Karl Frederick Gold Medal which he won for his student research on illumination of the inside of the eyeball. The rudimentary ophthalmoscope which he made was not up to that soon designed by Helmholtz, but the methods applied to the hitherto unsolved problem were very original.

After post-graduate clinical work in Heidelberg, Kussmaul went to Vienna where he fell under the spell of the rising Semmelweiss. In fact, Kussmaul arrived soon after Semmelweiss' friend, Kolletschka, died of a post-mortem infection, which triggered the whole investigation leading to Semmelweiss' new antiseptic routine on his ward. After serving two years in the German army as a medical officer, and learning a great deal about epidemic infections, Kussmaul settled down to practise in Kandern, a small town in which he had been stationed for some time in the army. In the next three years he published six first class papers, on such subjects as acute articular rheumatism, the spread of epidemic dysentry—a classic—and septic stomatisis, with the only autopsies outside of the series of Virchow and Rokitansky. Then, in 1853, the blow fell. Kussmaul came down with an ascending spinal cord disease which nearly took his life. He was left with limited use of his legs and had to give up all thought of practice. He therefore took further training with Virchow at Wurzburg and then began teaching at Heidelberg. For a further forty-two years this remarkable man taught German medical students and became a famous consultant. He is said to have given the first descriptions of periarteritis nodosa and of progressive bulbar palsy. He returned again and again to

the themes of his papers published while in general practice.

Endocrinology as applied to the adrenal glands provides one of the most fantastic stories of all. Sir Henry Dale has described it thus.

> "Dr. George Oliver, a physician of Harrogate, employed his winter leisure in experiments on his family, using apparatus of his own devising for clinical measurements. In one such experiment he was applying an instrument for measuring the thickness of the radial artery, and, having given his young son, who deserves a special memorial, an injection of an extract of the suprarenal gland, prepared from material supplied by the local butcher, Oliver thought that he detected a contraction or, according to some who have transmitted the story, an expansion of the radial artery. Whichever it was, he went up to London to tell Professor Schafer what he thought he had observed, and found him engaged in an experiment in which the blood pressure of a dog was being recorded, found him, not unnaturally, incredulous about Oliver's story and very impatient at the interruption. But Oliver was in no hurry, and urged only that a dose of his suprarenal extract, which he produced from his pocket, should be injected into a vein when Schafer's own experiment was finished. And so, just to convince Oliver that it was all nonsense, Schafer gave the injection, and then stood amazed to see the mercury mounting in the arterial manometer till the recording float was lifted almost out of the distal tube."

Everyone today knows that as the longevity of our population increases so does Parkinsonism, but few people know what manner of man was Parkinson. He was a remarkable general practitioner who was born, married, arrested, and buried in Shoreditch, London. He practised there all his life. He was a benign soul, but did not suffer fools gladly, especially if they were quacks or politicians. His medicine he learned as an apprentice to his father, an apothecary sur-

geon His first publication concerned three cases struck by lightning By the time of the French Revolution, however, Parkinson was to be found writing some wonderfully barbed pamphlets under the pseudonym "Old Hubert," and in his first he set out to demolish the silver-tongued Edmund Burke It was entitled *An Address to the Hon Edmund Burke from the Swinish Multitude* It concluded

> Let us then be all esteemed as swine together, we will be satisfied with the plain appellation of the *swinish multitude*, whilst you and your friends who are so fond of distinction, shall be termed HOGS OF QUALITY"

His next pamphlet was entitled *Pearls Cast Before Swine by Edmund Burke—Scraped Together by Old Hubert* Others followed, such as *The Budget of the People*, *Knave's Acre Association*, and *Masts and Acorns* Tom Paine had already flown to France after writing his *Rights of Man*, but James Parkinson kept busy at his practice, all the while issuing broadsides against the most corrupt ruling group known to British history He courageously appeared before the Privy Council to defend his imprisoned friends who merely sought parliamentary reform

With all this going on Parkinson found time to write books on medicine for laymen, and to investigate cancer, gout and diphtheria in his practice His *Chemical Handbook* of 1799 went into four editions in ten years In 1800 three more books followed, and then came his remarkable three volume geo logical work *Organic Remains of a Former World*

In 1817 he wrote the classic *Essay on the Shaking Palsy* With great insight he said that, 'The disease depends on some irregularity in the direction of the nervous influence by the wide range of parts which are affected, that the injury is rather in the source of the influence than merely in the nerves of the parts ' He noted, "Involuntary tremulous motion, with lessened muscular power, in parts not in action and

are few instances in which a disease has been more accurately, more graphically and more briefly described"

The remainder of Huntington's life was spent in general practice in the Catskill Mountains, where the outdoor life, and an interest in geology, birds, and sketching brought him great joy Even in the hardest times financially, he kept up a good library and continued to study hereditary chorea Huntington would have been the first to echo Jenner's words concerning practice in the country, "Here you may shut out as much of the artificial world as you please, and enjoy it more in the state in which Nature fashioned it"

To complete our excursion into neurology I should like to deal briefly with the life of James Ross, which has been brought so compellingly to our attention in recent years by that delightful historian, the neurosurgeon Sir Geoffrey Jefferson Ross was from Aberdeen, but spent several years on whaling expeditions to Greenland, and in general practice at Burnley, Sir James Mackenzie's town in Lancashire, before settling in Manchester Despite his demanding life as a family doctor he found time to write several important papers, one of which called forth the admiration of Thomas Huxley Ross unquestionably put Mackenzie on the right track concerning the "referred pain" of heart disease But Ross was an honest man, and gave credit for his hypothesis where it was due when he wrote, "In observing a case of pleurisy a few days ago and casting about for an explanation (of pain in the shoulder) one of the students suggested that, considering the connections of the phrenic, the pain might be caused by irritation of that nerve" Ross's later literary output consisted of fifteen short papers of concentrated clinical observation, eventually leading to the Chair of Clinical Medicine at Manchester, and of the highest type of recognition in the neurological world

If we may proceed from a discussion of pain to one on anaesthesia, I should like to introduce one of the most overlooked men in medicine, a courageous and enquiring general

practitioner, Henry Hickman In his thirty short years of life, in that paradise, Shropshire, Hickman proved that "the pain of surgical operations could be abolished by the inhalation of a gas" That gas was carbon dioxide A small pamphlet by Hickman in 1824 is his only publication on his series of animal experiments, in which parts of the body were removed without pain, thanks to carbon dioxide narcosis Only the *Gentleman's Magazine* of 1825 seems to have reviewed this pamphlet Thus, an appeal to the King of France, Charles X, was made, probably through some British painters in his employ, and the matter was finally passed to the Royal Academy, where it would seem from notations in the minutes of that body, that the whole proposition was received with the greatest skepticism There was one dissenter from the general view, Baron Larrey, the surgeon to Napoleon's armies It has been said that Larrey offered to be the first patient to undergo carbon dioxide anaesthesia However, Hickman returned to England and was dead, presumably of tuberculosis, within a year, at the age of thirty

Dr Herbert Thoms has laboured long and productively to retrieve from oblivion the lives of general practitioners such as John Stearns In the year of the French Revolution, Stearns graduated with highest honours from Yale College and took up the practice of medicine in his native Massachusetts In time he was to serve as an Army Surgeon and to attend lectures of such giants in Philadelphia as Shippen, Wistar and Rush At the age of thirty seven, and while practising at Waterford, New York, Stearns made his great contribution to obstetrics by a communication on the value of ergot, its uses and limitations He had already been using it for several years "with the most complete success" and wrote

> "It expedites lingering parturition, and saves to the accoucheur a considerable portion of time, without producing any bad effect on the patient. The cases in which I have generally found this powder to be useful are when

the pains are lingering, have wholly subsided or are in any way incompetent to exclude the foetus Previous to its exhibition it is of the utmost consequence to ascertain the presentation, and whether any preternatural obstruction prevents delivery, as the violent and almost incessant action which it induces in the uterus precludes the possibility of turning

With true candour he added

"The modus operandi I feel incompetent to explain It is a vegetable, and appears to be a spurious growth of rye On examining a granary where rye is stored, you will be able to procure a sufficient quantity from among the grain Rye which grows in low wet ground yields it in greatest abundance"

Stearns warned against the indiscriminate use of the drug, just as Withering, twenty years previously had had to warn against the near fatal doses of digitalis then being dispensed In fact, the parallel between the early work of the two men is uncanny When Stearns finally found time from his busy practice to codify his work on ergot, he published, in 1822, his classic entitled *Observations on the Secale Cornutum or Ergot, with Directions for its Use in Parturition* He began

It was not until the year 1807 that the ergot ever appeared before the public in a form to arrest the attention of medical men Some years previous to this, I was informed of the powerful effects produced by this article, in the hands of some ignorant Scotch woman, in the county of Washington Determined to try its efficacy, I procured a quantity from a field of rye My information was such as to impress upon my mind the necessity of extreme caution in my first experiments The continued influence of this impression upon my subsequent practice, has been a source of much consoling reflection It has tended to prevent those fatal errors which have so often occurred "

The chronicler of the life of Stearns, Dr Herbert Thoms, while he was himself a general practitioner at New London, Connecticut, was one of the first to urge the use of blood pressure determinations *routinely* in all major surgical procedures In the January, 1912 edition of *Surgery, Gynecology and Obstetrics* he wrote:

> "Although the clinical use of the sphygmomanometer is well established, its use in connection with surgical procedure is in no way general . . . Where the determination of blood pressure is used in this connection, the usual procedure is to record the pressure just before and immediately after, operation There is no doubt that in this way we have a valuable aid to the diagnosis of surgical shock, but we have no means of knowing how long such shock, if present, has supervened . . . It is the purpose of this paper to emphasize the importance of recording the systolic blood pressure, together with the pulse and respiration at five minute intervals."

The reader may be interested in a letter from Harvey Cushing to the Superintendent of the Massachusetts General Hospital recounting the history of a similar proposal made eight years earlier. He said.

> ". . . the Division of Surgery (M G H) appointed a committee to report on the subject This report appeared March 1904, (as) *Bulletin No. 2 of the Division of Surgery*, and the final conclusion of this committee was, as printed 'The adoption of blood pressure observations in surgical patients does not at present appear to be necessary as a routine measure.' I have always felt that this was one of the most interesting illustrations on record, of the reaction against the introduction of an instrument of precision into clinical use It is precisely what happened in the case of the thermometer, the stethoscope, the X ray, indeed of the watch itself."

When I think of Professor Thoms' background in general practice, I think of Sir James Mackenzie giving his great address, *The Future of Medicine*, in 1919 He said.

> "There should be in every school of medicine one or more teachers who have been in general practice for 10 to 20 years. Indeed it would be well if a young man were encouraged to enter general practice with the expectation that if he proved himself fit he should be qualified to become a teacher, and have the opportunity in a well equipped hospital of solving the problems he has had to face in his practice."

To hasten on to contributions in the realm of physics, I must direct your attention to that remarkable general practitioner of Heilbronn in Germany, Robert Mayer (1814–1878). At the age of twenty-four he worked out the pharmacological action of the newly-synthesized drug "santonin," a vermicide still in use today. At the age of twenty-eight, Mayer found himself as a ship's doctor, sitting in the harbour of Surabaya in Java, thinking about "forces" as related to "matter." In one blinding flash he saw the connection and, as a result, gave us the first law of thermodynamics. I would venture to suggest that he was on the deck, watching the unloading of cargo from the hold when he wrote, "In numberless cases we see motion cease without having caused another motion or the lifting of a weight; but a force once in existence cannot be annihilated, it can only change its form; and the question therefore arises; What other form is force, which we have become acquainted with as a falling force and motion, capable of assuming?"

As the cargo plummits to the dock and the already smoking brake shoe is applied to the drum of the huge winch, I can see him writing, "If, for example, we rub together two metal plates, we see motion disappear, and heat, on the other hand, makes its appearance, and we have now only to ask whether motion is the cause of heat."

Mayer conducted no experiments, but simply delivered himself of this tremendous generalization. Throughout his subsequent life as a general practitioner in Heilbronn he laboured to perfect his statement of it, and to test it with the

experimental findings of workers in the field The last twenty years of his life were spent, unfortunately, in a mental hospital, for he was broken by the vindictive priority merchants and publicity parasites who sought to belittle his contribution It is reminiscent of the Horace Wells and Semmelweiss tragedies

The patron saint of physicians working in the field of forensic psychiatry is Isaac Ray who was born in Beverly, Massachusetts, in 1807, and attended Phillips Andover Academy and Harvard Medical School He opened his general practice in Portland, Maine, and to support himself at first gave lectures in botany He published a book there, *Conversations on the Animal Economy, Designed for the Instruction of Youth* After a year's study in France he set up practice in Eastport, Maine, and it was there in 1838 that he published his great book *Medical Jurisprudence of Insanity* There had never been anything like it before, and in short order it went through six American editions and one British edition Some even compared it to the writings of Esquirol This was the undoing of a good general practitioner in Maine, but the best possible float to posterity Before long, Ray was called to the post of Medical Superintendent of the State Hospital for the Insane, and eventually to the Butler Hospital in Providence The fifty remaining years of his life saw one book or paper published by him annually He was truly a founder of American psychiatry

The founder of modern psychotherapy, however, was "a quiet, pleasant benevolent and hardworking French country doctor," A A Liebeault (1823–1904) From medical student days he had been interested in mesmerism, but it was not until two years after commencing general practice in Nancy in 1864 that he published his book *Sleep like States and the Effect of Mind on Body* The fact that only one copy was sold did not bother Liebeault nor his doting patients who called him, significantly, "Le bon pere *Liebeault*" The frugal peasants succumbed to his proposal that he would

treat them with drugs if they insisted, but he would have to charge them However, if he used only psychotherapy they would not have to pay a sous The fact is, however, that it was to Liebeault's little two-room clinic, set in his garden, that Freud journeyed to learn the rudiments of psychotherapy In rural Nancy he was to see at work a master therapist, a country doctor who was as successful with his therapy as he was interested in his patients Freud wrote of his visit, "I received the profoundest impression of the possibility that there could be powerful mental processes which nevertheless remained hidden from the consciousness of men " In the light of this excursion we can more readily understand Freud's saying that, "Psychoanalysis is the administrator of the estate left by hypnotism "

Space will not permit any extended discussion of the country practitioner of Warwickshire in England, George Bodington, who was a generation ahead of all others in the fresh air sanatorium treatment of tuberculosis He published a little book in 1840, with a title requiring seven lines of print, which was the beginning of the end for the criminal treatment of tuberculosis then in vogue purgation, exclusion of all fresh air, calomel, digitalis and blood letting He was one of Osler's favourites

Finally, and all too briefly, we come to that little band of general practitioners who have made other men's views available to us through their translations The greatest in all time possibly was Francis Adams, who spent his whole life as a rural practitioner at Banchory in Scotland, where he translated *The Genuine Works of Hippocrates* (1849) On entering grammar school in Aberdeen he had found he was frightfully deficient in the classics He set out to remedy this, and overshot his mark to such a degree that his translations and books on Greek philology, his Greek Lexicon of the names of plants and animals, and a book on the human placenta (1858) made him famous At Yale Medical School, during the Second World War, a Canadian general practitioner, Iser

Steiman, born in Russia and practising among the Ukranians on the Canadian Prairies, translated the amazing Russian aviation medical volume published in Moscow just before the war. The ever-helping hand of John Fulton and his catalysing influence in aviation medicine, rendered all this possible. I must make reference also to the New Hampshire general practitioner, Dr. Oliver Hayward, who is writing a definitive life of one of Yale's founders, Nathan Smith.

I trust that the portrait of general practitioners as contributors to medical science painted here, will inspire more students to seek general practice as the best continuation of their medical education, and as one of the most rewarding lives still open to man.

Chapter IX

Scientific Contributions by Medical Undergraduates

For many years I have been interested in investigating the productivity of young minds, particularly among medical students. A recurrent type of illness has given me time to make a very broad survey of undergraduate contributions to the medical and the general sciences and I have discussed 150 of these in my book *Young Endeavour*. I must say that the results have landed me in a great deal of hot water. My professorial colleagues see in this a plot to convert all medical undergraduates to the belief that students have discovered everything, and professors nothing. In this penultimate chapter I wish to add a few fresh names to the list of student contributors, and to generalize from these and from some of the material already published.

Much has been written on the nature of discovery, as if all discovery were made in a blinding flash of light and in no other way. Sometimes, it is true, the solution to an age-old problem has appeared suddenly on the horizon of an expectant searcher. However, to paraphrase Louis Pasteur's great dictum, fortune has, more often than not, favored the prepared mind. It is the preparation of the mind of the group included in this chapter that should be studied analytically, if one is to generalize from this limited sample to medical educational processes in the present. Sir Frederick Banting summed up the situation well, I think, when he said, "It is not within the power of the properly constructed human mind to be satisfied." Or, perhaps, one should listen to the

arch cynic Baudelaire when he says, "Life is a hospital in which every patient is possessed of the desire of changing his bed" Whatever the source or foundation of this spark of inquiry, of questioning and of trying to seek out better explanations of observed phenomena, it is one of the things that cannot be purchased It can be fostered, certainly, but as this chapter will show, it can also arise in the most unlikely places and find expression in the least auspicious setting

The nervous system has been well represented by such medical students as Marshall Hall (1790–1857) Hall came from a remarkable family in the cotton spinning and bleaching industry of Nottingham They were the first in the United Kingdom to use chlorine for bleaching Marshall and his inventor brother, Samuel, it is said, were raised on a mixture of religion and chemistry After an apprenticeship of four years to a pharmacist, Marshall Hall embarked upon medicine at Edinburgh, where he was known as a student who dissected from early till late every day As an undergraduate he contributed a paper to *Nicholson's Journal*, on a chemical research He was obviously popular with his colleagues and was elected president of the Royal Medical Society in his third year While a student at Edinburgh he began work on a manuscript of a book that was to be the turning point of his life, *Diagnosis of Diseases* He took the uncompleted manuscript with him when he left Edinburgh at the age of twenty four, and it was published three years later A copy of this book came into the hands of John Hunter's nephew, Matthew Baillie, in London, who was so impressed with its contents that he sent a host of patients to Hall to be studied. Eight years later Hall set up in practice in Keppel Street, in London, near the present site of the School of Tropical Medicine of the University of London He built a research laboratory in his house and was soon at work on a study of the circulation in animal tissues His first paper in this field propounded the argument that the capillaries were

the all-important structures in accomplishing the true work of the circulation

One day in his laboratory Hall found that the tail that he had just removed from a salamander jumped when he handled it With a curette he removed the spinal marrow that remained in this segment of the tail and thereafter found that touching it no longer caused it to move He carried out the same experiment on a snake, making a transection of the spinal cord just below the head He then found that even a breath of air would make the tail twitch, whereas if he wrapped it in cotton wool, no movement whatever was induced He also found that if he cut off the head of a turtle and touched the nose, breathing movements ensued And thus he came to generalize that one message sent into the spinal marrow reflected another one along the motor pathways For this work, on what would today be called "reflex action of the spinal cord," he was awarded his fellowship in the Royal Society He is also remembered for his pioneer studies on artificial respiration of more than a century ago

The controversy over sensory versus motor roots of the spinal cord, between scientists interested in reflex activity, has unfortunately obscured the early contributions of Sir Charles Bell (1774–1842) As an Edinburgh undergraduate he produced his beautiful *Atlas of Anatomy* That it was no mere 'flash in the pan" is proven by his subsequent works, *Essays on the Anatomy and Philosophy of Expression* (1824), *The Hand, Its Mechanism and Vital Endowments as Evincing Design* (1834), and by his many water-color sketches.

Thanks to the historical research of Dr Mary Brazier a whole new group of student contributors to our understanding of the brain's electrical activity has come to light The year 1870 saw not only two young Berlin instructors, Fritsch and Hitzig, mapping the brain's motor cortex by electrical stimulation, it also saw the production of a thesis at the St Petersburg Medical-Surgical Academy by a student, I A

Tyshletsky, on movement of the limbs on one side of a frog when the contralateral side of the brain was stimulated

Another student, Vasili Yakovlevich Danilevsky (1852–1939), the son of a watchmaker in Kharkov, received a gold medal in 1873 for his undergraduate work of an original nature on muscle physiology He then turned to the regulatory role of the cerebral cortex over respiration and blood pressure and published a paper on the subject in *Pfluger's Archiv* when he was twenty three years old His doctoral thesis, published in 1877, was entitled *Investigations into the Physiology of the Brain* Actually, therefore, Danilevsky was doing, unwittingly, in 1876, much of what Richard Caton had done in Liverpool one year earlier His experimental work probed the electrical activity of the brain as influenced by various types of noise, the inhalation of ammonia and the aroma of roast beef!

Just as Danilevsky's thesis was being published, another student discoverer, Napoleon Cybulski (1854–1919), was entering upon his medical training at the same famous school in St Petersburg, where Tarkhanov, who discovered the galvanic skin response, held sway As a second year student, Cybulski published a paper *Concerning the Influence of Body Posture on the Blood Pressure, Pulse and Respiration in Animals* On graduating in 1880 he received a gold medal for his study of the rate of transmission of nerve impulses By the age of thirty one he had become Professor of Physiology at Krakow

There Cybulski's great pupil, Adolf Beck (1863–1939), shared the interest of the forerunners already mentioned in the localization of function in the brain Pupil and teacher collaborated on a paper during Beck's first year in the laboratory, a study of the sense of taste in a patient lacking a tongue Soon Beck was writing independently on the excitability of peripheral nerve He progressed rapidly in the field of neurophysiology As he states in his thesis published in 1891, "The question arises, are there any currents in the

nervous centres of the brain and spinal cord? If so, are there changes in these currents during activity? And would the localizing of such changes be of any help in demonstrating a state of activity of a focal nature in the central nervous system?' Knowing nothing of Caton's work of 1875, Beck nevertheless confirmed and even enlarged upon Caton's findings. As Professor of Physiology at Lwow, Beck became a leader in neurological research, Rector of his university, and a courageous citizen in the First World War, when he rebuffed the Russians who sought to make Poland a Russian speaking satellite. As they retreated before the Germans they took Beck, as one of a group of hostages, to Kiev. In the Second World War the Nazis shot the leading scholars of Lwow and sought out Beck for extermination in the gas chamber. With a capsule of cyanide this old man of eighty cheated "The Master Race" of their demonic satisfaction.

As I noted in *Young Endeavour* the story of the development of surgical anaesthesia is replete with student discovery and application. Henry Jacob Bigelow, who first described in the medical press the use of ether at the Massachusetts General Hospital, had been interested in anaesthetic agents since his Harvard College days when he was charged with the preparation of nitrous oxide used in the annual students 'frolic.' Boston was not only the site of the introduction of ether for major surgery in 1846 but also the home of the 'Ether Chart" introduced by two Harvard medical students, Harvey Cushing and Amory Codman. In the fifty years that followed the great work of the medical student Morton here, the method of observing patients rendered unconscious by ether gradually deteriorated, and historians state that fatal consequences sometimes followed the careless manner in which these patients were supervised, often by students. Cushing and Codman had each lost a patient owing to the haphazard method of evaluating their condition, and as a result these two students introduced a chart for each surgical patient, on which respiration, pulse

and temperature were regularly recorded. These charts are taken so much for granted today that it is rarely appreciated that their introduction was truly a forward step in surgery. The two students, as might be imagined, went overboard in their criticism of the methods then in use, and the paper that they prepared greatly upset the hospital authorities of that day, who barely succeeded in persuading them not to publish it! Cushing never lost his interest in the problem of the unconscious patient, and six years after devising the ether chart with Codman, he brought back to the United States from Italy a modification of Riva Rocci's blood pressure-measuring apparatus so that systolic and diastolic pressures could be recorded on the anaesthetic charts in addition to the other data already mentioned.

Not to be outdone, Yale medical undergraduates were also stirring in the field of anaesthesia, and in 1910 an interesting ing paper by Herbert Thoms, an undergraduate, was published under the title *A New Apparatus for the Administration of Rectal and Pharyngeal Anesthesia*. His teacher, Dr. J. M. Flint, who had been an undergraduate researcher at Johns Hopkins under Osler, suggested that Thoms investigate the problem facing the anaesthetist in certain types of regional surgery. Thoms designed and built his own apparatus, which is very well illustrated in his undergraduate paper. I need hardly add that the inventive genius of Herbert Thoms has continued down to this day, and he continues to adorn the Faculty of Yale Medical School as one of its most original minds.

Another student contributor in the field of anaesthesia was J. Bailey Carter, who as a sophomore medical student at Rush Medical College pioneered, with Professor A. B. Luckhardt, the introduction of ethylene as a new anaesthetic for human use. Their publication in the *Journal of the American Medical Association* in 1923 is a highly entertaining chronicle as one reads of the effects of this gas on Carter the student, Luckhardt the professor, A. J. Carlson and Dallas

Phemister, as subjects The authors remark picturesquely, "We have been under the influence of ethylene two and three times on a given day for three consecutive Sundays No late or evil effects were in evidence"

The story of blood transfusion begins with a needy student, Arthur Coga, who, on the twenty third day of November, 1667, was given by Dr Lower and Dr King, at Oxford, a transfusion of fourteen ounces of sheep's blood This remarkable event took place before a group of bishops and parliamentarians, and for his part, the student was paid one guinea He made no complaint of any kind, and it is recorded that 'his pulse and appetite (were) better than before" The same performance was repeated before the Royal Society of London on December 12, 1667, also in a painless fashion *It is difficult to say precisely when the idea of blood trans*fusion was first published, but one reads in Aubrey's *Lives* in 1649 that Francis Potter, "a man of startling skill in me chanics," *originated the "notion of transfusion of blood'* Aubrey says

> "He told me his notion of curing diseases by transfusion of blood out of one man into another, and that the hint came into his head reflecting on Ovid's story of Medea and Jason, and that this was a matter of ten years ago (thus in 1639) About a year after, he and I went to try the experiment but 'twas on a hen and the creature too little and our tools not good"

By June of 1666, as the Royal Society records show, Lower *in Oxford was successfully transfusing blood from the jugular* artery of a mastiff to the jugular vein of an exsanguinated greyhound In the same year sheep's blood was being trans *fused into a mastiff* Before long lamb's blood was being transfused into a youth and an adult, in Paris, before the Academie des Sciences

Although the student Arthur Coga survived in England, there was one fatal outcome in Paris, which led to a decree,

in 1668, virtually putting an end to transfusion for several hundred years

The decree in France came partly as a result of a letter written by a medical student, Guillaume Lamy, on June 8, 1667 The letter protested vigorously against the transfusion one month previously by Professor J. B. Denys of sheep's blood into a youth in Paris. Lamy's remarkable letter was written to Moreau, the King's physician, and he castigates "the pretended usefulness" of transfusion in curing diseases of any kind Prophetically, Lamy cautioned against diseases produced by impurities in the blood He knew of the importance of the correct temperature of the blood, and he warned of the danger of coagulation At his age, not unnaturally, he believed that transfusions were better for old people than for young The Royal decree against transfusion, which stemmed from Lamy's extensive letter, permitted blood transfusion only when approved by a member of the Faculty of Medicine of Paris

The apparatus required for transfusion was not lacking, for Boyle gives an excellent description of Christopher Wren's ingenious brass device for lining up a vein under the tip of a syringe so that substances could be injected into the blood stream of a dog, in the year 1656 Boyle speaks of Wren as "our dexterous experimenter" and adds that one of Wren's dogs was given a warm solution of opium in sack, "whereupon the dog began to nod with his head, and falter and reel in his pace . After some time he began to come to himself again" It remains only to say that the dog grew fat and was stolen! Coming much nearer to the present, one should record that Norman Dott, known to all as the distinguished Scottish neurosurgeon, actually designed some of the early equipment for transfusion in human beings from artery to vein while he was still a very young medical student Another Scottish student who assisted his teacher, Dr. James Graham, of Edinburgh, with the first organized group of blood donors was none other than Sir James Learmonth,

well known both in America and in the United Kingdom for his work on the surgery of the sympathetic nervous system and its effect upon peripheral blood vessels.

The cardiovascular field has, of course, been the happy hunting ground for many undergraduate investigators. Eduard Friedrich Wilhelm Weber, the younger of the two famous brothers, at age 19, measured the pulse velocity for the first time and was able to show that Bichat's theory that the pulse wave was felt simultaneously in all arteries was fallacious. Four years later, in 1829, the younger Weber took his degree in medicine at Halle.

Almost a century later, in 1916, a second-year medical student at Johns Hopkins University, Jay MacLean, discovered the anticoagulant, heparin. MacLean's story is worth recounting because it symbolizes the grit and determination of some medical students in this field. MacLean has written, "The discovery of heparin came as a result of my determination to accomplish something by my own ability." His story begins with the San Francisco earthquake, in which his family lost everything. This catastrophe did not rob MacLean of his ambition to study medicine at Johns Hopkins University, however, and one finds him, even as a high-school student in California, reading Simon Flexner's great study, *Medical Education in the United States*. As a premedical student he worked in a gold mine in the Mojave Desert at twenty five cents an hour. He learned to do blood counts and urinalyses at an infirmary to pay his way as an undergraduate science student at the University of California, and at one time even scrubbed the decks of the San Francisco Bay ferries to support himself. After completing one year of the medical course at the University of California he sought to transfer to Johns Hopkins University, but the Dean at San Francisco obligingly wrote ahead to Hopkins to say that MacLean was "not the kind of man Hopkins sought." However, MacLean was not to be downed, and he spent the next fifteen months as an oil driller to accumulate

enough money to attend Johns Hopkins Medical School despite the fact that he had already been refused there once. He arrived in Baltimore just as classes were beginning and was lucky enough to find a vacancy in the second year. He made straight for the laboratory of Professor Howell, whose textbook in physiology he had read while a student in California. Howell shuddered in his shoes as he faced this one man tornado from the West and thought that he was sending him on a suitably long goose chase when he put him to work on a search for clotting substances in the blood. Although the result was not premeditated, of course, it is typical of the contrary nature of MacLean in so many ways that he ended up not with a clotting substance, but with the important anticlotting substance, heparin. His ability to recover it from the dog's liver was a most important factor in making it available for use in transfusions. His predecessor Lamy, in Paris, had seen clearly, two hundred and fifty years *earlier, how important anticoagulants would be.*

Although medical undergraduate discoverers have not had a monopoly on the cardiovascular system, as they seem to have had on the lymphatic system, they have done well! Professor Eugene Landis began his observations on capillary function as an undergraduate at the University of Pennsylvania. Professor Wilder Penfield began his work on intravenous blood substitutes in his fourth year of the medical course at Johns Hopkins University, working in Professor Howell's laboratory. The title of his publication, which appeared in the *American Journal of Physiology* in 1919, was "The Treatment of Severe and Progressive Haemorrhage by Intravenous Injection." With great facility, Penfield, during his surgical internship at the Peter Bent Brigham Hospital in Boston, then went on to write a paper on the hydronephrotic ureter. He had done some of the work for this publication while at Oxford with Sherrington, who had cautioned him, in his search through the medical literature, to limit himself to one ureter only!

The eminent authority in pediatric cardiology, Dr Helen Taussig, began her work in this field, while a first year student at Boston University School of Medicine, on the disposition of the muscle bundles of the heart This interests she continued at Johns Hopkins University, with signal success in the clinical field

I am happy to be able to record that one of my student contemporaries at McGill University, Kenneth A Evelyn, developed there his photoelectric method of measuring the hemoglobin content of blood for clinical laboratory purposes He is now professor of medical research at the University of British Columbia

Before leaving the blood vessels, one should recall the remarkable injection technique that Johann Nathanael Lieberkuhn (1711–1756) devised during his busy career By using a special fat-free injection medium for the vessels and then corroding away the surrounding tissues with nitric or dilute sulfuric acid, he was able to show the course of the blood vessels in any organ that he studied Lieberkuhn, known to most medical students because his name is attached to a special type of gland in the intestine, began his university training by studying theology at Halle and Jena After three years, however, he transferred to medicine, graduating at Leyden in 1739, as one of Boerhaave's pupils His dissertation was on the vermiform appendix and the valves of the colon For this work he was elected a member of the Royal Society of London One year before he graduated he designed and built his own solar microscope, and one should not be surprised to learn that his name has been perpetuated in microscopy in connection with the illumination of opaque objects His contemporary, G C Reichel (1727–1771), made an unusual discovery while a medical student he found that by immersing plants in watery solutions of Pernambuco wood he could study the distribution of the sap within the plants *in vivo*

Another physician botanist of note was Robert Hooper (1773–1835) He was born in London and graduated with

the degrees of Master of Arts and Bachelor of Medicine at Oxford University in 1804, where he had been a student at Pembroke College. The first of his three undergraduate publications, *Observations on the Structure and Economy of Plants,* was published in 1797. A year later *The Anatomist's Vade Mecum, Containing the Anatomy, Physiology and Morbid Appearances of the Human Body* was published. He also translated from the Latin *Plenck's Hygrology, or Chemico-Physical Doctrine of Fluids of the Human Body.* My interest in him began with his *Illustration of the Morbid Anatomy of the Human Brain and Its Membranes,* published in 1826, one of the first volumes dedicated solely to neuropathology. Two years later he presented a volume based on 4,000 autopsies at St. Marylebone Infirmary in London.

The year of the French Revolution saw the birth in England of that great figure in medicine, Richard Bright, whose life of almost threescore years and ten encompassed some of the most moving dramas in medical discovery. Born in Bristol, Bright enrolled in the medical course at the University of Edinburgh in 1808. With the capture of Iceland by Britain during the Napoleonic wars, great interest was stimulated in it. Bright applied to Sir George Steuart MacKenzie to join his expedition to study the new territory. Bright wrote the botanical and zoologic chapters of MacKenzie's *Travels in Iceland,* and drew some of the illustrations. While there, Bright collected several Icelandic bibles and manuscripts. In addition, he made a study of the geology of this volcanic island and together with Sir George vaccinated the natives. The landscapes that he drew are very pleasing to the eye. After a period of five months on this expedition Bright returned to the United Kingdom and enrolled at Guy's Hospital under Sir Astley Cooper. While at Guy's, he made his first drawing of a granular kidney and presented his first paper, at the Geological Society, on the stratification of the rocks seen at Bristol. In the same year he was elected to the Physical Society, where he presented a paper *On the Use and Abuse of Blood-Letting.*

Bright soon developed an intense interest in pathological anatomy and began to draw specimens seen in the post-mortem rooms Despite all this he kept up his interest in geology, even when in 1812 he returned to Edinburgh as a pupil of Dr Gregory He graduated with the medical degree in September, 1813, his thesis subject being *Contagious Erysipelas,* which was also the subject of Walter Reed's first paper written as an intern at Kings County Hospital, Brooklyn It is said that Bright compared puerperal fever and erysipelas for their method of spread, and he stated that his former lecturer in midwifery at Guy's Hospital, London, John Haighton, had already proved the contagious nature of puerperal fever Bright was president of the Royal Medical Society, the remarkable student group that was the earliest medical society in Great Britain His discourse, read as president in 1812, was *On Gangrene* He was contemporary in the Society with such giants as Marshall Hall, discussed above, John Davy, the brother of Sir Humphry Davy, and Thomas Addison Bright was preceded by a couple of years only by John Elliotson, the man who became famous at University College Hospital, London, for his attempts to use hypnotism to provide surgical anaesthesia, one of his American pupils being the famous John Collins Warren of Boston who, in 1846, introduced ether for surgical anaesthesia The versatile Sir Arthur Hurst republished Bright's thesis more than a century after it was written

The subsequent history of Richard Bright and of his investigations into the disease named after him is so well known that it would be utterly superfluous to detail it here One important aspect of his career, however, concerns this study of student discoverers He mentions in his Gulstonian Lectures

> *I have lately had great assistance from the intelligent* and zealous cooperation of three of my young friends and pupils, Mr Barlow Mr Tweedie, and Mr Rees These gentlemen have found from experiments made upon the urine of 296 patients, taken promiscuously in Guy's Hos-

pital, that 44, that is 15 per cent, were coagulated by heat, that 37, or 12½ per cent, gave precipitates with nitric acid, and 26, or 8¾ per cent, gave precipitates with both."

Another student, Robinson, examined all the microscopical sections of the kidneys under study In *Guy's Hospital Reports,* started in 1836 by Bright as part of his program of investigating the true causes of diseases, Barlow and Rees reported their "Observations on Patients with Albuminous Urine" Robinson wrote a book on kidney pathology Rees later presented a book on the chemistry of blood and dedicated it to Bright, saying what it had meant to him to have had "the kind encouragement received from you when, as a mere boy, I first entered upon the study of pathological chemistry"

To read Bright's own contributions to *Guy's Hospital Reports* is to get a liberal education In the first series he wrote on "Diseased Arteries in the Brain" He returned to this subject in his Lumleian Lectures He also wrote on "A case of Fatal Epilepsy from Local Disease of the Brain" A year later he discussed the diagnosis of tumors situated near the base of the brain, and in his report of 1837 he analyzed two very interesting cases of aphasia He was studying cerebral localization of function long before Hughlings Jackson Bright had an uncanny grasp of cerebrovascular problems at a time when this was certainly not fashionable For instance, he discusses in his report forty cases of cerebral haemorrhage, which he regarded as being related to disease of the kidneys

From May until October, 1842, he was able to have two wards at Guy's Hospital set aside for the study of kidney disease with a small laboratory between the wards Bright says that this was 'the first experiment which, as far as I know, has yet been made in this country to turn the ample resources of a hospital to the investigation of a particular disease by bringing patients laboring under it into one ward properly arranged for observation" In fact, it was the beginning of the

clinical investigation units for the study of disordered human physiology in which Sir Thomas Lewis and Paul Dudley White were to spend so much of their lives, one hundred years later

The development of bone and of teeth occupied a number of medical student investigators John Goodsir (1814–1867) came to his work in medical school with a rich background of microscopical observations on the marine forms dredged up from the Firth of Forth, where he lived His study of sponges provided many clues when he came to investigate bone growth While an undergraduate at Edinburgh he embarked upon a study of the embryonic development of teeth, and he charted the stages through which the teeth passed until eruption was complete This formed the basis of his later work carried on as curator of the Museum of the College of Surgeons, Edinburgh, where he produced his monumental treatise on the development of bone in general Even at that early date he had clearly the concept of bone builders versus bone absorbers, and of the balance that had to be struck between these two activities It is of note that he eventually succeeded Monro Tertius in the Chair of Anatomy at Edinburgh, thus bringing to an end a reign by three members of the same family for a hundred and twenty eight years

The famous Jonathan Hutchinson (1828–1913), as a student, was studying the notched teeth in infantile syphilis In the year of his qualification in medicine he began his observations on inflammation of the eye in infants and young persons suffering from hereditary syphilis His contemporary, Julius Wolff, in Germany, was just graduating with a thesis written on the experimental reproduction of bone Wolff thought of bone as being in a continual state of flux, and like another student investigator, Oldfield Ward, he studied the neck of the femur to show how the details of structure met the problems of function With the help of his engineering friend, Culmann, Wolff made a design analysis of the neck of the femur that led him to his law of bone formation, which

was that the amount of growth in a bone depends directly upon the need for it

Another contemporary was Joseph Samson Gamgee, who was born in Leghorn in 1828 and took up the study of medicine at University College Hospital, London As an undergraduate he won the Liston Clinical Medal for his essays on the treatment of fractures A year before he graduated, his paper *On the Advantages of the Starched Apparatus in the Treatment of Fractures and Diseases of the Joints* was published This small (89 page) volume, printed by H K Lewis in London, contained Gamgee's revolutionary idea of getting the fractured bone into proper alignment as soon as possible even with an anaesthetic if necessary, rather than waiting for the soft tissue swelling to subside, which was then the usual procedure Gamgee applied the porous paste-board splints and starched bandages even to sprains and to diseased joints to bring them rest He sought to provide the patient with a light and therefore portable, strong splint in the form of a cast that could be cut open without difficulty He wrote that he was weary of "multifarious and inefficient contrivances rich in wood and leather, splints, straps and buckles, hooks and screws, bolts and hinges, which have been prolifically devised for the treatment of fractures" The famous surgeon John Erichsen, himself once a student contributor,* came to depend very much on Gamgee and his methods during the latter's surgical residency at University College Hospital Gamgee was meticulous in the fitting of casts and wrote of the need to respect the soft parts, he said

> "There must be no squeezing like that of an old college friend's hand when seen after a long absence the soothing surgical pressure is like that which you interchange with the hand of a lady"

* Erichsen, of Danish descent wrote his thesis, at age twenty four, *On the Influence of the Coronary Circulation on the Action of the Heart* He was particularly interested in the role of ventricular fibrillation in circulatory failure

Only passing mention can be made here of the work of Alfred Smee (1818–1877), who, as a London medical student in 1840, made up splints composed of chalk and gum in his little laboratory within the walls of the Bank of England

The greatest contributor to the field of high altitude physiology in the last century was Paul Bert, one of Claude Bernard's brilliant pupils and his successor in the Chair of Physiology at the Faculte des Sciences at Paris Bert's great study, *La Pression Barométrique*, which was translated into English during the Second World War by Professor and Mrs Fred A Hitchcock, of Ohio State University, is a volume of over 1,000 pages It is a mine of information and truly a bible for anyone active in the field of aviation medicine

Paul Bert's early history is interesting He was born in the year 1833 at Auxerre and embarked on an engineering training He gave this up to qualify in law, and he actually took his bar examinations successfully However, like Oliver Wendell Holmes and Semmelweiss, he found the world of the law unsatisfying, and he turned his active mind to medicine, receiving his medical degree at the age of thirty His graduation thesis, an important document, concerned the grafting of animal tissues Certainly, his work on skin grafting set the stage for much of the plastic surgery that was performed during and after the war of 1870 Three years after graduating from the Faculte de Medecine, Paul Bert took up the study of high altitude physiology and he was a pioneer in the construction of decompression chambers that could simulate high altitudes His volume *La Pression Barometrique* is also a landmark in the history of respiratory physiology His greatest accomplishment was to show that altitude sickness, as it was then called arose from a lack of oxygen rather than from a diminution of total atmospheric pressure However, it was the thesis of another medical student that excited interest generally in the symptoms of men exposed for long periods to high altitude and thus to lowered atmospheric pressure

This student, Alphonse Gal, graduated in 1872, as William Osler did. His thesis, which he defended before the Faculte de Médecine at Montpellier, was a study on the dangers of working at several atmospheres' pressure and thereafter being decompressed rapidly to the barometric pressure that one finds at sea level. During the summer vacations of 1868 and 1869 Gal was engaged on a sponge fishing boat, off the coast of Turkey, where he encountered cases of decompression sickness or "the bends," which he studied very thoroughly. His thesis of 1872 thus brought into the literature for the first time extensive clinical studies in this important field.

Alphonse Gal presented a very meaty thesis. His observations range into the hundreds and were not limited to mere peripheral phenomena. The effects of high pressures on respiration, circulation and pulse rate are very well documented. He mentions in detail four cases of paraplegia caused by too rapid ascent from the depths of the sea. Two deaths from similar causes were described, one of the divers having become aphasic. The diving took place in the Greek archipelago, along the coast of Rhodes and near Bengazi. He described such symptoms as muscle pains, localized to the deltoid and to other muscles most used by divers,—arthritic or joint pains, as he called them—and the "fleas" under the skin. All add up to the picture of decompression sickness as it is known today. It is uncanny to read the descriptions of Alphonse Gal nearly a century after his student observations and to realize what a truly great contribution this medical pioneer made as he served on board the sponge diving ships. He pursued his observations on "the bends" with suggestions for prevention, such as shallower dives, shorter periods under water at depth, and above all, slower decompression of the man—in other words a gentler ascent to the surface. He also records that his preventive measures definitely decreased the occurrence of paraplegia in his men.

The field of infection and infectious agents has known many interesting student contributors, among them Theo-

bald Smith I have found a group of approximately twenty-five student researchers in the early years of Johns Hopkins University School of Medicine, most of them in this area If one peruses the twelve volumes of reprints given to William Osler by former students when he left Baltimore in 1905 to become Regius Professor of Medicine at Oxford, one sees immediately that many of his students carried out undergraduate researches that were actually published before they received their medical degrees For instance, T R Brown, of the class of 1897, first reported eosinophilia in trichinosis W G MacCallum did his remarkable work on malaria in birds before graduation Eugene Opie's first paper on hematozoa appears in the third of the twelve volumes presented to Osler W J Calvert s studies on the blood vessels of the lymphatic gland and the treatment of peritonitis in dogs were both published a year before his graduation The work of Mabel F Austin on endocarditis appeared during her student days J M Flint s paper on the distribution of *Escherichia coli* was also an undergraduate effort Other student work published before graduation includes that of Dorothy Reed after whom a special type of cell has been named, of Florence Sabin, and of Adelaide Dutcher on tuberculosis, in which she describes the pioneer home visiting program in the field of tuberculosis that was instituted by Osler F C Goldsborough wrote his first paper as an undergraduate on syphilitic disease of the cerebral arteries Louise Tayler-Jones, as an undergraduate did work on the kidney worm of swine One of the most notable papers of all was that of Ernest Sachs on amaurotic family idiocy One could add, also, Benjamin Schenck who described the causal agent in sporotrichosis

The introduction to these twelve volumes contains a dedicatory letter to Osler from his former students

> "We wish to record our debt of gratitude to you for the influence you exerted on us when we were your students it is with the deepest regret that we see you leave the Johns Hopkins University, but we are certain

> that the influence exerted by you during your sojourn there will continue as a great force in the upbuilding of American medicine We give you Godspeed, rejoicing that we could have been your pupils"

It is little wonder that Osler wrote in his own copy, "My chief treasure a splendid record"

Just too late for these volumes was the work on enzymes by Milton Winternitz, a second year student at Hopkins, who published his first work in Hoppe-Seyler's Zeitschrift in 1905

One student who fascinates me was Duchesne, who in his graduation thesis at Lyons in 1897 described the protective effect of injecting moulds into the body simultaneously with pathogenic micro organisms It was forty years later that Howard Florey, at Oxford, undertook a systematic examination of this protective phenomenon attributable to penicillium and other moulds Duchesne's imaginative work obviously should have been followed up much sooner It suggests, however, that not all the theses written by medical students have been carefully perused by professors in medical faculties In addition, there has been no standard method of even getting at the titles of contributions by medical students, suggesting in what low regard the student thesis is traditionally held

It would be tempting to go on to a discussion of the early contributions of Berzelius, the chemist, G Ray Brow, of Montreal, on the experimental production of pancreatitis, Otto Loewi's early student work with Schmiedeberg in pharmacology or that of W Scott Lang on internal diseases of the knee joint as an undergraduate in Edinburgh Or one could turn back four centuries to discuss William Turner, who, while a student at Cambridge, wrote a classic of botany He, poor man, was imprisoned for preaching without a license! He became a member of Parliament and dean of Wells Cathedral, but was eventually suspended for nonconformity in religious matters Nevertheless, his *Herbal* marks

the beginning of scientific botany in England More recently, one could, with profit, review the undergraduate labors of Cecil Drinker at Harvard, of W W Gerhard (1809–1872), Comroe, Christensen, Isaac Starr and John Howard at the University of Pennsylvania, or C M Carpenter and Willard Allen at the University of Rochester, or of Stafford Warren at the University of California, on systemic intoxication related to exposure to sizable doses of X-rays And more recently still one could review the work of the Belgian medical student, Litz, who suggested in 1934 the use of colchicine for altering mitosis One could also recall the discovery in 1955 of a Harvard medical student, Miss Ann Michelson, of the mutant mouse at Bar Harbor, Maine, which has come to be used as an important laboratory animal in the study of muscular dystrophy

The career of John Farquhar Fulton was certainly one of the most unusual medical undergraduate's which Boston ever saw Coming from St Paul, Minnesota, he graduated with his Bachelor of Science degree at Harvard in 1921 and his medical degree in 1927 In those six intervening years he spent a great deal of his time at Oxford, first as a Rhodes scholar and later as a Fellow of Magdalen College, where he produced a book, *Muscular Contraction and the Reflex Control of Movement,* in which he prophetically discussed a chemical theory of nerve-impulse transmission Before he graduated in medicine, Fulton wrote more than thirty papers, on subjects ranging from curare, procaine hydrochloride, muscle histology and decerebrate rigidity, to the early Phrenological Societies and their journal With Cohn, Minot and Murphy, he wrote a paper on the active principle in liver that was effective in the treatment of pernicious anemia

This early beginning was but a foretaste of things to come, so that at the time of his death, early in 1960, John Fulton had a bibliography of almost 500 published items, including some of the most deservedly popular textbooks and scientific monographs in the English language

Some medical student prodigies are hard to classify, as, for instance, Elias Friedrich Heister (1715–1840), the short-lived son of Lorenz Heister He began in medicine at the age of sixteen, and studied at Helmstadt, Berlin and Leipzig At the age of twenty-one he published his great *Apologia* on which he had been working Osler said of him, "I have not met an 18th century writer who knows so well and quotes so often the *Religio Medici*"

Besides the well known bibliographers Conrad Gesner, John Shaw Billings and Robert Watt, discussed in *Young Endeavour*, there is another to remember, William D Chapin A paper by Dr. A L Peirson, *Remarks on Fractures* (1840), noted that Chapin was "a very intelligent medical student . . . whose excellent project is endorsed by well-known New York physicians and professors, proposes to publish a yearly index to original communications in the medical journals of the United States, classified by authors and subjects" Chapin was of the cut of Poole, who conceived the idea of his well known *Index* while an undergraduate at Yale, and Dewey, who originated his library system of classification while a student at Amherst College

Finally, two remarkable careers were launched in student research, those of Sir Walter Morley Fletcher (1873–1933), the first Secretary to the Medical Research Council of Great Britain, and Joshua Lederberg, who shared the Nobel Prize in 1958 with his fellow geneticists Beadle and Tatum *Fletcher graduated in medicine from St Bartholomew's* Hospital Medical School, London, in 1900, having already conducted considerable research at Cambridge on sympathetic nerves and especially on muscle He set out to determine the time relations of the appearance of carbon dioxide and lactic acid as related to muscle contraction and the supply of oxygen

Some would wonder why Fletcher should press on to a medical qualification when he was already successfully launched on a research trajectory It is fortunate for the

world that he did qualify in medicine for he thus became Pasteur's "prepared mind favoured by fortune" in 1914 when the Medical Research Council was first created in Britain As its permanent Secretary, Fletcher became the guiding force in much of its development right up to the time of his death in 1933 A nonconformist in religion, with a nature sloping towards the sunny side, as Osler used to say, Fletcher took seriously the role of medical research in modern society As his research associate of college days, T R Elliott, put it

> 'From Cambridge, where the looms for every pattern of web in biological knowledge were all in such busy activity he looked out over England and saw how little her people were receiving in bodily welfare from all the newly woven science"

From his bedrock apprenticeship in research, Fletcher was able to cut through the mists of a hobby type of medical investigation which hung over the Thames, even after the First World War It has been said of him, 'There were times when his grasp exceeded human reach and his criticisms of medical practice made him appear unduly intolerant of those in Harley Street" However, his advice was wisely sought by the Rockefeller Foundation in its programme for medical education and research in the United Kingdom, and by the trustees of the late Sir William Dunn As undergraduates at Oxford we were raised on the story that Sir William, a wealthy stockbroker, had left his fortune "to the glory of God, and that Sir Walter Fletcher had been quick to act as *interpreter for the courts, with the result that Cambridge* secured the Sir William Dunn School of Biochemistry and Oxford the Sir William Dunn School of Pathology!

Joshua Lederberg, on the other hand, was "shanghaied" *from Columbia University, where he was a respectable medi*-cal student, to spend a summer in research in genetics at Yale University with E L Tatum, with whom he was to share the Nobel Prize As Tatum, only faintly apologeti-

cally, says, "Lederberg was successful in showing genetic recombination between mutant strains of E coli, K-12, and never returned to medical school, but continued his brilliant work on bacterial recombination the first demonstration of a process analogous to a sexual process in bacteria" Certainly, a remarkable combination of circumstances played a part in setting the stage for the medical student's 'discoveries concerning the organization of the genetic material of bacteria" to which Beadle referred so warmly in his Nobel address

While there is undoubted truth in Goethe's phrase, "Not every man fits every hour," Lederberg made the most of his opportunity Such opportunities are not rare at Yale, let it be said, for there a thesis has been required of every student upon graduation, for the past 150 years It is the best form of do it yourself" education

A few catalytic souls, together with the spirit of adventure, can so pervade a medical school that the acquiring of *new knowledge and the development of new investigational techniques* become second nature to all. Again, as a clinician, I stress the fact that this in no way militates against the best *interests of the patients being treated here* On the contrary, it ensures that well prepared physicians with open minds, rather than stereotyped physicians with closed minds, will be looking after patients The standards of alertness and curiosity of the teaching staff soon rub off on the students who pass through their hands As a teacher in a medical school I would say that the students provide much less of a problem than do the faculty when it comes to creative curiosity One of my British colleagues recently told me that he felt, alas, that his medical students entered ignorant but curious, and left ignorant but no longer curious

Most medical students would be shocked if William Harvey were to turn up today, to lecture on his discovery that the blood moves in a circle, for he would remind *them*, as they scribbled so stenographically

> "How base a thing it is to receive instruction from others' comments without examination of the objects themselves The rather as the book of Nature lies so open and is so easy of confirmation '

Still, some students, preserving an inate sense of humour and of proportion, would understand Harvey's insistence on self-education, and would even gain support and momentum from Maurice Maeterlinck's lines

> 'At every crossway on the road that leads to the future, each progressive spirit is opposed by a thousand men appointed to guard the past The least that the most timid among us can do is not to add to the immense dead weight which nature drags along"

And if, weary from ward rounds, our student should still have sixty seconds to read before falling asleep at night, he would get support from the words of Archibald MacLeish

> "There exists in our society the strange and ignorant be lief that the life of imagination lies at an opposite pole from the life of the enquiring mind that men can live and know and master their experience of this darkling earth by *accumulating information and no more* Men who believe that, have in effect, surrendered their responsibilities as men"

Thus, to conclude, I must say that if the scientific contributions of medical students mean anything they surely mean that we as medical educators must spend our lives opening rather than closing doors The rarest commodity in the world is inspired grey matter and this we must nourish and enhance if we believe in social and scientific progress

Chapter X

Medical Contributors to Music and Literature

THE physicians to be discussed in this chapter are so numerous that some system seems essential. Therefore, I shall discuss, first, contributors to music, then those who contributed both to music and literature, and, finally, those who made their mark in the literary field alone Some of the most eminent will be found in that remarkable middle group, but even without them I would be faced with the problem of discussing some one hundred musicians and three hundred men in the field of letters Some selection has been made, necessarily, and it is hoped that the interest which may be awakened by a representative group of contributors will increase and eventually extend to the entire field

In one of his delightful biographical studies, Dr Herbert Thoms has told of Professor Walter Channing lecturing at Harvard, early in the last century, when an organ grinder took up his position outside the open window and proceeded to drown out the clinic on obstetrics Channing sat down and waited until the melody had been ground out with a few notes missing, saying to his students, "Apollo, gentlemen, was the god of music as well as the god of physic." Over the centuries this has been demonstrated in most doctors' lives, in which music has provided a much needed relaxation at the end of a day of listening to the grief of others The ability to play some instrument, large or small, may save a doctor's respect of his fellow man after having his faith sorely tried.

To sample this vast cavalcade of harmony, over the centuries, let us imagine that we are arranging a festival or concert at which music written by physicians will be performed

eighteen of whom could play the piano—one of them sitting with his back to it—a sort of musical transposition of the viscera

To return to our United Nations concert. As the artists arrived in waves one would be stuck by the variety of instruments carried on stage—some doctors sporting half a dozen. The performers came from the oddest fields of medicine, too We would find that imposing white haired figure, Helmholtz, at the grand piano given him by the Steinway Company of New York just one hundred years ago The more modern compositions would be played by Nathan Chandler Foot, the Cornell pathologist, and by Vincent McGovern, the Australian pathologist who uses Foot's silver stain daily The string section of our doctor's orchestra would include Boerhaave, surrounded by an assortment of instruments, Phipson of London with a few reference books he had written on violins, Max Schultze the histologist, Leo Buerger of Buerger's disease, and Eloesser the American surgeon, home long since from helping the Loyalist Government of Spain Ready to strike up his Hungarian violin, which he regarded as his passport to America and to a medical degree at Chicago, would be Max Thorek The cellos in evidence would belong to Sir Richard Owen, and Henle the histologist. Caspar Bartholin would be there with his Grecian flutes, but content with the common variety would be Withering and Laennec William Henry Stone the physiologist would be polishing his bassoon

As two Bostonians arrived, in the persons of the surgeon Oliver Cope, and David Berlin, their opposite numbers would enter from New Haven—Sunderman, Byron Hardin, and the eclectic Emerson Stone wearing two hats, one for his M D and the other the Bachelor of Music degree, David Smith a fourth year medical student would trundle in his cello, and bringing up the rear, would be the boy choristers John Farquhar Fulton and Richard Cabot

In the wings would be Thomas Young of Rosetta Stone

fame, sputtering that he expected to play the clavichord but most of those in America had been cornered by the Yale Art Gallery Beside him would be the leader of the Doctor's Chamber Orchestra in Buenos Aires, Dr Vollenweider Cathcart would be telling him how he introduced promenade concerts into Britain Not to be outdone, William Wallace would be insisting that he was the first in Britain to write symphonic poems Rudolf Schindler, absent mindedly producing a gastroscope, would insist that the Physicians' Orchestra which he organized in Munich was never bettered, while Brocklesby would keep them all quiet, hopefully, with his "musical therapy," backed up by the "Italian Sydenham," Baglivi The disconsolate Dr Cheve would walk out of the building mumbling to himself that no one wanted to hear about his books on the tonic sol-fa and musical education At the door he would encounter Dr. Donald Macdonald, a graduate of the University of Texas, just arriving to carry the bass role in an oratorio by Dr Thomas Arne (1710–1778) of Covent Garden and *Rule Britannia* fame Expecting to sing also would be Ortiz Tirado, the orthopaedic surgeon who began singing to raise money for a children's clinic in Mexico

The works of at least two quasi medical composers might be performed, the works of Brahms dedicated to the surgeon pianist Billroth, and Rachmaninoff's great *Piano Concerto No 2 in C Minor* dedicated to his physician Dahl, who had cured him of a terrible depression Engelmann would be showing to all who cared to read, his letter from Brahms concerning the reception which the string quartet, dedicated to him, had been given Brahms had concluded it, " the great glue-boiling public was in ecstasies " Another quasimedical contributor, Manuel García the Spanish singer, could probably be seen in the wings demonstrating the laryngoscope which he invented, to Dr Isaac Jones, the otolaryngologist of Los Angeles, an accomplished organist and pioneer in aviation medicine

The concert over, the doctors of the orchestra would then cross Forty-second Street to Broadway As they passed the bars they would hear the strains of *Casey Jones* and *There'll be a Hot Time in the Old Town Tonight*, written by Dr James B Naylor Finally, they would relax at Mindy's where two medical stalwarts took turns at the well worn piano, Russel Myers the Professor of Neurosurgery at the University of Iowa—who, years ago, studied medicine between appearances at Mindy's, and the rotund Royal Air Force version of Mr F Waller, Wing Commander Robert Maycock His rendition of his old hospital's song, *St Bartholomew's Blues*, would further augment this musical marathon by Apollo's men One might hear in the distance the British surgeon Shuckburgh's *Yankee Doodle*, and Dr Brewster Higley's *Home on the Range* as a long day closed

As for the master musicians who also contributed to literature, I have selected an even dozen who seem, to me at least, to express something very basic in human nature, and that is man's desire to create something where nothing was before, through music or through writing The drive to do this may stem from the doctor's frequent inability to "do" anything for a patient, in diseases which at present condemn us, as a profession, to console rather than to cure

The Jesuit physician Athanasius Kircher (1602–1680) believed in one kind of music for each of the four temperaments of man He was an orientalist, an excellent organist, and an expert on liturgical music He wrote a volume of 1 200 pages summarizing all that was known about music up to his time It treats of the physiology of the voice, of hearing, the theory of time, rhythm, and harmony He discovered in the Library of St Salvator's Monastery, in Messina, the oldest piece of Greek music which we have—a fragment of the first Pythian ode of Pindar He insisted on the importance of Egyptology as a study One of his most interesting contributions was his book *The Powerful Magnetism of Music*

Close to him, in point of time, comes John Arbuthnot

(1667–1735) who, as a fiery Scot, became quite a political pamphleteer concerning the need to end the war with France His *History of John Bull* made him famous, and he was an intimate of Johnson, Swift and Pope He was renowned for his sacred compositions, of which *As Pants the Hart* is perhaps the best known today Thomas Campion was both an excellent poet and authority on counterpoint Sir William Petty was an elegant Latin Poet and a Professor of music in Gresham College, London, among a host of truly outstanding accomplishments Thomas Lodge, the describer of the "plague" in 1603 was another accomplished poet-physician musician

The magic flute of Oliver Goldsmith carried this truant from medicine over much of Europe His plays and poetry are still universally enjoyed We would do well to recall that it was the luckless Goldsmith who, in 1761, brought to England the clinical teachings of his fellow musician Leopold Auenbrugger, who introduced percussion of the chest, abdomen and head, after watching barmen rapping on barrels in his father's wine cellar

Let us think for a moment of the subject of one of Dr Herbert Thoms' biographical sketches, Dr Elihu Hubbard Smith, one of the Connecticut Wits" of last century, that flourished in Hartford A talented musician, he wrote an opera, published the first collection of American verse, and edited the first medical journal in America He began as a busy country practitioner In that tradition, of course, is Edward Jenner, whose catholicity of tastes and accomplishments seems to have known no bounds He played the flute to perfection, and wrote such lovely poems as *Signs of Rain* —which gives an intimate picture of the glorious Gloucester countryside In the vaccination controversy Jenner enjoyed the loyal support of his fellow musician, Dr John Ring

The surgical life of Theodor Billroth has overshadowed his contributions to musical literature His volume *Psychophysiological Aphorisms on Music* is a classic Sir Ronald

Ross (1857–1932) of malaria fame composed chamber music and wrote several poems, one of which, *In Exile*, was hailed by John Masefield as "by far the most splendid poem of modern times." The fame of Fielding Garrison as a writer, historian and musician is legendary. Another historian, Dr. John Hemmeter, was an outstanding pianist and writer of music for choral groups and orchestra. Francis Brett Young was yet another physician pianist and composer. He has set to music some of the finest poems of his brother physician, Robert Bridges. He wrote poems himself, as well as several plays and twenty novels.

Coming to modern times we see that music and literature still find expression in the talented fingers of Albert Schweitzer, organist, writer and healer, and in those of Karl Stern, the Montreal pianist and psychiatrist, who has written an interesting autobiographical study, "Pillar of Fire." I should love to hear his comments on the perspicacity of the 17th century doctor, Philippe Douth, who wrote poems on the danger of certain kinds of music causing what he called "frenzy" in youths!

Coming, finally, to the medical contributors to literature, I would like to include a few of the lesser known poems of merit. Horace Walpole who was a discerning man of letters said, "Is it not extraordinary . . . that two of our very best poets, Garth and (Erasmus) Darwin, should have been physicians? I believe they have left all the lawyers wrangling at the Turnpike of Parnassus." As I have indicated, there are between 200 and 300 medical contributors to the world's literary store who deserve to be read. We can sample but a few, beginning with the Latin verses of 400 years ago, penned by Euricius Cordus, the physician father of the discoverer of ether, Valerius Cordus. As true as when written are his lines:

"God and the doctor we alike adore
When on the brink of danger, not before,

The danger past, both are alike requited,
God is forgotten and the doctor slighted"

And yet, for centuries physicians who were poets were discriminated against! We have only to recall the comment made on Haller's application for the post of city physician at Berne in his native Switzerland, "He is a poet Why should he want to be a hospital physician?" Both Haller and Conrad Gesner left us fine poems on the Swiss alpine regions and their beauties

Osler put the problem very well when he wrote

"Literature has often been enriched by those who have deserted medicine for the muses But to drink deep draughts at Pierian springs unfits, and when the thirst is truly divine should unfit, a man for the worrying rounds of practice It is shocking to think that had Goldsmith secured the confidence of the old women in Bankside, Southwark, we should probably never have known the Vicar, Olivia, or Tony Lumpkin Still worse, to think of what we should have lost had Keats passed on from a successful career at Guy's to obtain even a distinguished position as a London Surgeon! Happily, such men soon kick free from the traces in which the average doctor trots to success"

Listen, however, to Thomas S Perry, the Boston writer and critic

"312 Marlborough Street, Boston
Jan 12, 1916"

"Dear Dr Cushing

"I am very much obliged to you for your excellent paper on Dr Garth I read his *Dispensary* over only last winter and I much appreciate your lucid exposition of the poem and of the poet's nature

"But what a lesson you give the world of what a busy man can do You deserve all our gratitude The only disturbing thing that I can foresee is that some day some

literary gent will enter your Peter Bent Brigham hospice, snatch up your dread knives and try to show how expert they are in surgery! Yet I wouldn't trust one of them with nail scissors

"You have done the trick however, and you really *must* send a copy to the Boston Public Library

"Once more I thank you very warmly and am

Yours most cordially
Thomas S Perry"

Or we may hear the view of the American physician poet Silas Weir Mitchell speaking at a dinner of the alumni of the University of Pennsylvania in 1912

"What you have said to me as a scientist and physician, and as a writer of fiction and verse obliges me to be personal When success in my profession gave me the freedom of long summer holidays, the despotism of my habits of work would have made entire idleness an ennui I turned to what, except for stern need, would have been my lifelong work from youth—literature—and bored by idleness, wrote my first novel There is a lesson for you, never be idle

"In any land but this, such an experiment as a success ful novel would have injuriously affected my professional career as a medical consultant, or so I was told by an eminent English physician I need not say this is not the American way of looking at life If you give your best to medicine and the law, you may write novels or verse, or play golf, or ride the wildest of hobbies"

Discussing his own work he said on another occasion

"All my best verse—why, I cannot say—has been long in my mind in summer time and has found expression in the fall, but this applies less to the drama poems, which were summer products and, like all verse for me, hard labor Now and then a line or two comes easily, but as a rule it is slow, patient biding on the shore and waiting to see what cargo the ships will fetch me for choice About the

> value of certain medical gains which the world owes me, I am serenely sure—eye strain, headaches, rest treatment, and so forth—but of the relative value of my verse I have no assurance
>
> "I wish to put on paper the process by which a poem originates in my mind and is carried to such completion as I am capable of I do not know what others say about this First, there is the belief that certain things can be better said in verse than in prose, that what is said competently in verse means the higher thought in the best form of the most condensed English Also I state my belief that *a man who can write in the language of poetry must, as soon as he begins to deal poetically with a subject, think in rhythms At least that is my own case The moment the thoughts begin to assume form, they assume rhythmic form For the choice of forms of rhythm I find it difficult to state reasons Sometimes one gets caught in a rhythm* not suited to the subject, or, as did Browning, he *misses* the best form, but as a rule one finds the right rhythmic instrument through which to develop ideas
>
> "I have often considered it a pity that we had not the history of some great poem, Keats' "Ode to a Grecian Urn, from the egg down to the final development and ultimate corrections

If I were asked by a medical student what I would put in a library made up of the literary contributions of medical men, I would have to answer thus of the Latin poets, Lucretius, translated by another physician John Mason Good, in autobiography, Smollet's *Roderick Random,* Ramón y Cajal's *Recollections of My Life,* as translated by E Horne Craigie of Toronto, Axel Munthe's *San Michele* for a picture of medicine in the slums of Naples, rife with plague, and his *Red Cross and Iron Cross,* a World War I study, and Sir Arthur Keith's jaunty and warm story of his life, one of the greatest cross sectional views of the medical career in recent times, and the recently published *Fringe of the Clouds* by Air Marshall Sir Philip Livingston, F.R C S

For historical novels and short stories, I would suggest that the student read those of Anton Chekhov, as he describes a great but downtrodden people, listless and hopeless A brighter canvas he would find painted by Wilder Penfield in his novel on Ur of the Chaldees, *No Other Gods* (There being nothing left at the original site of this great city, Dr Penfield, on his world circling journeys, used to explain to travel agents that he wanted them to get him as far as Ur Junction, so that he might complete his work!) In biography I would put before all others Harvey Cushing's *Life of Sir William Osler* We shall return to Osler's prose presently

As to novels written by doctors, the student would not run out of fuel if he stocked up on all of Somerset Maugham and A. J Cronin I note that the most recent bibliography of Maugham's works runs to one hundred pages alone He has been writing his farewell number for years, and enjoying it Plays by Ibsen, the student of medicine, might be varied with those of Claude Bernard and Brown Séquard, the French physiologists, and commented upon by Raynaud, the chronicler of Moliere's time If the student were good at Slavonic languages I would give him Purkinje's translations in Czech, of such classics as Shakespeare, Schiller and Tasso For relaxation he could read Conan Doyle's unending collection of Sherlock Holmes, the character made up from bits and pieces of well known medical teachers of the past. If our medical student could read Spanish, and he should be able to in this world, I would direct him to the poems of Juan Diaz Covarrubio, who was shot by a firing squad in Mexico in the last ditch stand by the reactionaries of 1859 who were determined that the democratic process should never enter that land His crime was that he had cared for the injured of the opposite side His literary and medical work were so well known that his death brought down his executioners, and ushered in a better life for Mexicans Manuel Acuña, a romantic poet, wrote a remarkable study on his reaction to finding in the morgue, for autopsy, the body of a girl he had

once loved When he had the poem completed, he quietly committed suicide Two poets and physicians of Spain, which our student should read, are Vital Aza and Gregorio Maranon, the outstanding endocrinologist For whimsical prose he should read Pio del Rio Hortega's essay *Art and Artifice in the Science of Histology*, and for the story of anaesthesia, pharmacologist Chauncey Leake's poem *Letheon*

Our student should have at his elbow Dr Roget's *Thesaurus* If the student were married and had children, he would smilingly read to them that century old comic book, with gruesome punishments forecast, *Struwwelpeter*, written in 1845 by Heinrich Hoffman (1809–1894), a German physician Or he might read them the fairy tales written by the German surgeon Volkman under the name Richard Leander,' or the children's classics written by S Weir Mitchell, to aid the Children's Hospital and the Sanitary Commission Fair of Philadelphia, *The Children's Hour*, and *The Wonderful Stories of Fuz Buz the Fly and Mother Grabem the Spider*

If our student were an inquisitive and industrious type he would compile for himself, and for other medical students to come, an anthology of letters written by physicians to physicians such as those of James Jackson, Jr , to his father in Boston, and by Rudolf Virchow to his parents One more recent example, with its background, may be cited In October, 1912, a tall Vancouver Islander, Philip Livingston, went up to Cambridge to study medicine Today he basks in the sunshine of his beloved Island once again and in the respect paid him by the villagers among whom he practices, home from the sea, truly, but also from the air Few men can have lived such a career, from the bottom rung to the top of the ladder in a great air force, only to retire" to a very demanding practice His experience is beautifully chronicled for all to read in his *Fringe of the Clouds*, from which the following passage, on Cambridge, is extracted

"I passed through First Court, under the arch that contained the porter's lodge, then along the "chimney" and turned right beneath a cluster of chestnut trees that stood with their thick boughs over-hanging the wall of the Fellows' Garden, and crossed the Lane in the direction of Malcolm Street The night continued clear and deep set with stars and a hint of moon The college walls stood out in bold relief or lay in shadow according to the angle and setting of the gas lamps Wherever light glimmered, it revealed the quiet encouraging strength of ancient stone Here it was, between Chapel, cloisters and kitchens, that the nuns of the Benedictine Order of St Radegund had roamed in the tenth century These structures had known the footfalls of scholars who, by the good agency of Geoffrey Ridel, Bishop of Ely, obtained rectorial rights in 1180, thus conforming to independent monasticism It was here that heavy feet came tramping in the boots of Cromwell's Ironsides in 1642 Whatever great movement had come about, Revolution, Commonwealth, Restoration, its expression could be traced in the Colleges of Cambridge from the days of the small halls and hostels of the eleventh century

"Already I was experiencing the emotions that Cambridge awakes in each young heart so blessed as to share her history It was as if a thousand voices whispered, 'we loved it here You too will love it, not only now but always, for this is your time, the three best years of your life'

"And so, when I entered my sitting room I crossed to my desk and wrote

"'Dearest Mother,

Thank you ever so much for allowing me to come up to this beautiful place

Your ever affectionate son,

Phil'"

Let us not forget that the earliest form of "publication" was to address a letter describing one's investigations and results to another physician or to a Society. Perhaps the following examples will serve to illustrate the possibilities.

Letter from Dr Edward Jenner, to Dr Heberden, 1778

"Sir When you are acquainted with my motives, I presume you will pardon the liberty I take in addressing you I am prompted to it from a knowledge of the mutual regard that subsists between you and my worthy friend Mr (John) Hunter When I had the pleasure of seeing him at Bath last Autumn, I thought he was affected with many *symptoms of the Angina Pectoris The dissections (as far as I have seen) of those who have died of it, throw but* little light upon the subject. Though in the course of my practice I have seen many fall victim to this dreadful disease, yet I have only had two opportunities of an examination after death In the first of these I have found no material disease of the heart, except that the coronary artery appeared thickened

As no notice had been taken of such a circumstance by anybody who had written on the subject, I concluded that we must still seek for other causes as productive of the disease but about three weeks ago, Mr Paytherus, a surgeon at Ross, in Herefordshire, desired *me to examine with him the heart of a person who had died of the* Angina Pectoris a few days before Here we found the same appearance of the coronary arteries as in the former case But what I had taken to be an ossification of the vessel itself, Mr P discovered to be a kind of firm fleshy tube, formed within the vessel, with a considerable quantity of ossific matter dispersed irregularly through it This tube did not appear to have any vascular connection with the coats of the artery, but seemed to lie merely in simple contact with it.

"As the heart, I believe, in *every subject* that has died of the Angina Pectoris, has been found extremely loaded with fat, and as these vessels lie quite concealed in that substance is it possible this appearance may have been overlooked? The importance of the coronary arteries and how much the heart must suffer from their not being able duly to perform their functions (we cannot be surprised at the painful spasms) is a subject I need not enlarge upon

therefore shall only just remark that it is possible that all the symptoms may arise from this one circumstance

"As I frequently write to Mr H I have been some time in hesitation respecting the propriety of communicating the matter to him, and should be exceedingly thankful to you, Sir, for your advice upon the subject Should it be admitted that this is the cause of the disease, I fear the medical world may seek in vain for a remedy, and I am fearful (if Mr H should admit this to be the cause of the dis ease) that it may deprive him of the hopes of a recovery "

From O W Holmes to W Osler, Boston, Jan 21, 1889

"My dear Sir,—I have rarely been more pleased than by your allusions to an old paper of mine There was a time certainly in which I would have said that the best page of my record was that in which I had fought my battle for the poor poisoned women (The Contagiousness of Puerperal Fever) I am reminded of that Essay from time to time, but it was published in a periodical which died after one year's life and therefore escaped the wider notice it would have found if printed in the American Journal of the Medical Sciences A lecturer at one of the great London Hospitals referred to it the other day and coupled it with some fine phrases about myself which made me blush, either with modesty or vanity, I forget which

"I think I will not answer the question you put me I think oftenest of the "Chambered Nautilus," which is a favourite poem of mine, though I wrote it myself The Es say only comes up at long intervals, the poem repeats itself in my memory and is very often spoken of by my cor respondents in terms of more than ordinary praise I had a savage pleasure, I confess, in handling those two Professors—learned men both of them, skilful experts, but babies, as it seemed to me, in their capacity of reasoning and argu ing But in writing the poem I was filled with a better feel ing, the highest state of mental exaltation and the most crystalline clairvoyance, as it seemed to me, that had ever been granted to me I mean that lucid vision of one's

thought and all forms of expression which will be at once precise and musical which is the poet's special gift, however large or small in amount or value There is some selfish pleasure to be had out of the poem, perhaps a nobler satisfaction from the life saving labour "

Or, let us look at a letter from John S Billings

"January 5, 1892"

"I have yours of January 4th I do not in the least understand what you mean by acknowledging the receipt of your 'suspension in the Surgeon General s Department' Who has been suspending you? What are you suspended from? And why do you feel particularly thankful about it?

"With the compliments of the season,

"Yours very sincerely,
JOHN S BILLINGS"

Or a post card from Osler to Cushing in 1909

"I dreamed of you last night—operating on Hughlings Jackson The great principle you said, in cerebral surgery, was to create a commotion by which the association paths were restored You took off the scalp, like a p m incision —made a big hole over the cerebellum and put in a Christ Church (Oxford)—whipped cream wooden instrument and rotated it rapidly Then you put back the bone and sewed him up You said he would never have a fit again I said solemnly I m not surprised' Hughlings Jackson seemed very comfortable after the operation and bought three oranges from a small Neopolitan who strayed into the Queen Square amphitheatre"

Or, Lauder Brunton to Fielding Garrison, 27 September 1915

" There is no particular interest in Laycock's letter, but the man was very interesting personally He had a most profound confidence in himself and I have heard him say 'Twenty five years ago gentlemen I wrote a book which was then half a century above its age but the age

is now gradually beginning to appreciate it.' The odd thing was that in saying this he understated the truth The book was *Nervous Diseases of Women,* and such neurologists as Ferrier and Crichton Browne still look upon it as in advance of the age Laycock was really the original of Sherlock Holmes Conan Doyle got the idea from Joe Bell, but Joe Bell got his ideas from Laycock, who was Bell's teacher as well as mine He used sometimes to make very brilliant diagnoses, and at others, great mistakes I have known him diagnose waxy degeneration of the capillaries of the small intestine, and post mortem examination proved the correctness of the diagnosis He has also been known, simply on walking through a ward, to look at a man and say 'This patient has cancer of the pancreas.' Again he was correct One day he was telling the students a great deal about a child and he said to them, Gentlemen, I know all this from my observation of the mother' 'Please, Sir,' said the woman, 'I am only his stepmother' Another time he was saying, 'This I can tell, gentlemen, from the condition of the patient's teeth' 'Please, Sir, shall I hand them round?' said the patient, taking the teeth out . . ."

I promised the reader a taste of Osler's prose Here he discusses the Master-Word

". . . Though a little one, the master word looms large in meaning It is the open sesame to every portal, the great equalizer in the world, the true philosopher's stone which transmutes all the base metal of humanity into gold. The stupid man among you it will make bright, the bright man brilliant, and the brilliant student steady With the magic word in your heart all things are possible, and without it all study is vanity and vexation The miracles of life are with it, the blind see by touch, the deaf hear with eyes, and dumb speak with fingers To the youth it brings hope, to the middle-aged confidence, to the aged repose True balm of hurt minds, in its presence the heart of the sorrowful is lightened and consoled It is directly responsible for all advances in medicine during the past twenty five cen-

turies Laying hold upon it, Hippocrates made observation and science the warp and woof of our art Galen so read its meaning that fifteen centuries stopped thinking and slept until awakened by the De Fabrica *of Vesalius, which is the very incarnation of the master word With its inspiration Harvey gave an impulse to a larger circulation than he wot of, an impulse which we feel to-day Hunter sounded all its heights and depths, and stands out in our history as one of the great exemplars of its virtues With it Virchow smote the rock and the waters of progress gushed out, while in the hands of Pasteur it proved a very talisman to open to us a new heaven in medicine and new earth in surgery the Master Word is Work"*

Here are two brief but expressive poems about Osler, the first of the two being by a physician

An eye whose magic wakes the hidden springs
Of slumbering fancy in the weary mind
A tongue that dances with the ready word
That like an arrow seeks its chosen goal,
And piercing all the barriers of care,
Opens the way to warming rays of hope
A presence like the freshening breeze that,
As it passes, sweeps the poisoned cloud aside
An ear that 'mid the discords of the day,
Swings to the basic harmonies of life
A heart whose alchemy transforms the dross
Of dull suspicion to the gold of love
A spirit like the fragrance of some flower
That lingers round the spot that this has graced,
To tell us that although the rose be plucked,
And spread its perfume throughout distant halls,
The vestige of its sweetness quickens still
The conscience of the precinct where it bloomed

William Sydney Thayer

William the Fowler, Guillaume l'Oiseleur!
I love to call him thus and when I scan
The counterfeit presentment of the man,

I feel his net, I hear his arrows whir,
Make at the homely surname to demur,
Nor on a nomination lay a ban
With which a line of sovran lords began,—
Henry the Fowler was first Emperor

Asclepius was Apollo's chosen son,
But to that son he never lent his bow,
Nor did Hephaestus teach to forge his net,
Both secrets hath Imperial Osler won
His winged words straight to their quarry go
All hearts are holden by his meshes yet.

The author of this sonnet was Basil Lanneau Gildersleeve, Professor of Greek at Johns Hopkins University, 1876–1915

Shall we contemplate the pungent prose of that master neurologist, Sergeant Surgeon to the King, Wilfred Trotter, F R S (1872–1939), well known for his treatise of 1915 on *Instincts of the Herd in Peace and War.*

"The vociferous opposition met with by the ideas of Charles Darwin and of Lister probably did nothing to hinder the spread of these, and probably brought them within reach of a larger number of people capable of accepting them than would have been the case if the opposition had been well behaved Again it was not noisy prejudice that caused the work of Mendel to lie dead for thirty years, but sheer inability of contemporary opinion to distinguish between a new idea and nonsense That this same inability may be shown even by the most eminent workers in science scarcely needs demonstration for anyone at all aware of the history of knowledge, but it may be illustrated by an anecdote which we owe to the third Lord Rayleigh and which is to be found in the delightful *Life* of that very great and wise man J J Waterston was an engineer who interested himself in mathematical physics, and in 1845 wrote a paper on the molecular theory of gases which was ten or fifteen years in advance of his time and anticipated much of the work of physicists no less eminent than Joule, Clausius, and even Clerk Maxwell.

> The only contemporary judgement on this paper that survives is that of the referee of the Royal Society to whom it was submitted He said, "The paper is nothing but nonsense.' What Waterston might have accomplished, if he had had the recognition and encouragement upon which this genius seems to have been unusually dependent, is beyond conjecture He did not get them His work lay in utter oblivion for forty five years until it was exhumed by the pious efforts of Rayleigh He himself lived on, disappointed and obscure for many years, and then was overtaken by a yet deeper obscurity, for as the result of some strange accident or a long gathering impulse of despair, he disappeared and left no sign"

When we have said all this about physician-writers, however, we leave even more unsaid Who shall estimate the literary influence of physicians such as Rabelais, Eugene Sue (1804–1857), Thomas Campion (1567–1620) of *Cherry Ripe* fame, George Crabbe (1754–1832) the poet rector, John Locke, Abraham Cowley, Warwick Deeping, John Brown (1810–1882) of *Rab and His Friends,* Thomas Lovell Beddoes the poet (1803–1849), William Henry Drummond (1854–1907) Canada's Poet of the Patois, Norman Bethune the Canadian surgeon in Spain and in China, Humphry Davy the medical student poet, John French (1616–1657) who wrote in 1651 *The Art of Distillation,* Pio Baroja the Spanish writer (who used to ask me in Paris interminable questions about the "Esquimales" in the Canadian north), Erasmus Darwin the poet, Sir Wilfred Grenfell of the Newfoundland mission,—all between the publication of John of Gad desden's *Rosa Anglica* of 1492, and Lord Moran's *Anatomy of Courage* (1945)! Nor must we forget the translators, of the Rosetta Stone—Dr Thomas Young, of Hippocrates—the great family physician, Francis Adams, and even the founder of modern shorthand—Dr Timothy Bright (1551–1615)!

Not all professors are born orators nor writers Here, how-

ever, in John Barclay of Oxford, do we find exemplary clarity

"Anatomy may be likened to a harvest field First come the reapers who, entering on untrodden ground, cut down a great store of corn from all sides of them These were the earliest anatomists of modern Europe, such as Vesalius, Fallopius, Malpighi, and Harvey Then come the gleaners, all gather up ears enough from the bare ridges to make a few loaves of bread Such were the anatomists of last century—Winslow, Vicq d'Azyr, Camper, Hunter, and the two Monroes Last of all come the geese, who still contrive to pick up a few grains scattered here and there among the stubble, and waddle home in the evening, poor things, cackling with joy because of their success Gentlemen, we are the geese"

And now, to conclude, let us enjoy a few short poems by Sir Charles Sherrington, O M, the Harvey of the nervous system

Green and Black

When sunny clouds sail over Kent
and meadow breadths lie striped with hay,
the heart in stillness of content
hears angels' feet on every way

The church vanes scatter sun fed sparks,
the oxen knee their elm set pool,
the farm's old pensioned spaniel barks
to greet the children back from school

And when, night come, the moon is up,
below the stars the branches through,
the valley, like a sacred cup
day drained of wine, draws beaded dew

It scarce might be to guess that lie
not distant hence two hours by train

places unglad, where life goes by
with little bliss to balance pain

Where the black houses scowl in rows
and vomit waste on the strait street,
where childhood worse than roofless goes,
and misery drags with evil feet

Where droop worn faces pale as foam,
wrath voices night long curse and chide,
and the wife sobs in her starved home
because new life beats 'neath her side

Then gazing upward at the stars
believing this earth one with them
I ponder what flaw there too mars
the glittering cosmic diadem

I think I love old people most

I think I love old people most,
they seem so staunchly brave,
their eyes say little of the ghost
that they perforce all have

And they go full of things that were,
and carry them about,
and where we do not care they care,
yet doubt not where we doubt

Now in the cloister few the feet that roam

Now in the cloister few the feet that roam,
ours that must stay, who little can than wait,
exchange our tidings, good, ill, early, late,
and send our 'god speed' to them past the foam,
the young folk, splashed with death in the trenched loam
Ay, oil the hinges of the ancient gate,
keep burnished bright the goblet's silvern state
against the hour shall hail the soldier home

You stately tower, from high you saw them go,
and have full many doughty scenes and fair
watched and swung bells above, shattering the air
to honour heroes, you too wait as though
of our poor hearth bound presence scarcely ware
you heard from far the filial bugles blow.

1916

Oxford

The night is fallen and still thou speakst to me,
what though with one voice sole, with accents many,
tongued turret and tongued stream, tracked pasture fenny,
and cloister spirit trod, and centuried tree,
and, bondsmen loosed in Time's tranquillity,
thy bell-discharged hours If wharfage any
thine 'tis where Age shall nursing late his penny,
smile at long last to hand him Charon's fee
And now, below, through shadows starr'd, a boat
steals by me laden with singing and young laughter,
and, higher, a wide flung casement casts afloat
pulses of waltz the which white robes sway after,
vowed Priest of Beauty, these thy shrines among,
thou kneelst with old folk, thou that dancest with young

Selected References

Chapter I

Bonnette, P Centenaire de la mort du Baron Larrey *Presse Médicale*, *33* 486, 1942

Dible J H A surgeon of the Revolution, Consulate and Empire *Med Hist*, *3* 100–107, 1959

Juillard, J E Dominique Larrey—chirurgien de guerre Thèse M D Fac Méd Paris, 1946, 76 pp Libraire L Arnette

Larrey, D J *Memoirs of Military Surgery* Baltimore, Jos Cushing 1814, 2 vols

Mott, Valentine *Travels in Europe and the East* Harper, N Y, 1842 452 pp

Pariset, E Jean Dominique Larrey, 1766–1842 *Bull Acad Roy Méd*, *11* 217–251, 1845–6

Roberts, A E S D J Larrey *Med J Southwest (Bristol)*, *71* 134–135 1956

Sauerbruch, F *A Surgeon's Life* London, Deutsch, 1953, 297 pp

Chapter II

Blake, E M Yale's first ophthalmologist—Rev Peter Parker, M D *Yale J Biol Med*, *3* 387–396, 1931

Cushing, Harvey Dr Garth The Kit Kat poet (1661–1718) *Bull Johns Hopkins Hosp*, *17* 1–17, 1906

Frank Johann Peter The people's misery mother of diseases 1790 Transl by Henry Sigerist *Bull. Hist Med.*, *9* 81–100, 1941

Greenwood, M *Some British Pioneers of Social Medicine* Oxford Univ Press, 1948, 118 pp

McMenemy, W H *James Parkinson (1755–1824)* Ed Macdonald Critchley London, Macmillan, 1955, 268 pp

Osler, W Rudolf Virchow the man and the student *Boston Med Surg J*, *125* 425–427, 1891

Shryock, Richard *Medicine and Society in America—1660–1860* New York Univ Press, 1960, 182 pp

Sigerist, H What medicine has contributed to the progress of civilization *Internat Rec Med Gen Practice Clinics*, *168* 383–391, 1955

Thoms, Herbert Gordon of Aberdeen *Am J Obst Gyn*, *15* 229, 1928

Thoms, Herbert The Signing Doctors *Am J Surg*, *30* 390–394, 1935

Woodham Smith, C *Florence Nightingale* London, Constable, 1950, 615 pp

Chapter III

Cohen, Lord, of Birkenhead *Sherrington—Physiologist, Philosopher and Poet* Springfield, Ill, Thomas, 1958, 108 pp

Fulton, J F Sir Charles Scott Sherrington, O M (1857–1952) *J Neurophysiol*, *15* 167–190, 1952.

Harrison, Ross G On the origin and development of the nervous system studied by methods of experimental embryology Croonian Lecture *Proc Roy Soc* Series B, *118* 155–196, 1935

Liddell, E G T Charles Scott Sherrington *Obit Not Fellows Roy Soc*, *8* 241–270, 1952

McMenemy, W H Santiago Ramon y Cajal *Proc Roy Soc Med*, *46* 173–177, 1952

Pi Suñer, A, and J Pi Suñer Ramón y Cajal and the physiology of the nervous system *J Nerv Ment Dis*, *84* 521–537, 1936.

Retzlaff, E, and J Fontaine Reciprocal inhibition as indicated by a differential staining reaction *Science*, *131* 104–105, 1960

Smythies, J, W C Gibson, and V A Purkis The distribution and morphology of boutons terminaux in the human cerebrum A quantitative study *J Comp Neurol*, *108* 173–224, 1957.

Chapter IV

Figuier, Louis *Les Aerostats* Paris, Jouvet, 1887, 291 pp

Fulton, J F Louis H Bauer and the rise of aviation medicine. *J Av Med*, *26* 92–103, 1955

Glaisher, J *Travels in the Air* London, R Bentley, 1871, 398 pp

Haldane, J S, and J G Priestley *Respiration* Oxford, Clarendon Press, 1935, 493 pp

Hill, Leonard *Caisson Sickness and the Physiology of Work in Compressed Air* London, Edward Arnold, 1912, 255 pp

Robinson, Victor Discovery of the balloon *Ciba Symposia*, *5* 1618–1623, 1943, Origin of aviation medicine *Ibid*, *5* 1624–1638, 1943, Aviation medicine in the A E F *Ibid*, *5* 1639–1646, 1943

Schaefer, G, and W Naumann Physicians as pioneers of air travel *Ciba Symposia*, *3* 1026–1032, 1941

Chapter V

Acrel, O *Chirurgiska Handelser* Stockholm, H Fougt, 1775, 650 pp

Bayle, M J M Les fondateurs de la doctrine française de l'aphasie These M D Univ Bordeaux Imprimerie Biere 1939

Courville, C B The ancestry of neuropathology *Bull Los Angeles Neurol Soc*, *11* 1–19, 1946

Dax, Marc Thèse M D Memoire pour servir à la topographie medicale d'Aigues Mortes Montpellier, J Martel, 1799, 33 pp

Dax, Marc Lesions de la moitie gauche de l'encéphale coincident avec l oubli des signes de la pensee Lu au congres méridional tenu à Montpellier en 1836 *Gaz Hebdom de Méd et Chir*, *11* 259–260, 1865

Elsberg, C A. Edwin Smith Surgical Papyrus and diagnosis and treatment of injuries to the skull and spine 5000 years ago *Ann Med Hist*, *3* 271–279, 1931

Fulton, J F A note on Francesco Gennari and the early history of cytoarchitectural studies of the cerebral cortex *Bull Inst Hist Med*, *5* 895–913, 1937

Jefferson, Geoffrey The prodromes to cortical localization *J Neurol, Neurosurg & Psychiat*, *16* 59–72, 1953

Tizard, Barbara Theories of brain localization *Med Hist*, *3* 132–145, 1959

von Bonin, G *The Cerebral Cortex* Springfield, Ill, Thomas, 1960, 396 pp

Walker, A Earl The development of the concept of cerebral localization in the nineteenth century *Bull. Hist Med.*, 31 99-121, 1957

Chapter VI

Ackerknecht, E H *A Short History of Psychiatry* New York, Hafner, 1959, 98 pp

Adrian, E D The scientific approach to medical research In *Lectures on the Scientific Basis of Medicine* Univ London, Athlone Press, 1953, 396 pp

Babinski, J Guerison d un cas de melancholie à la suite d un acces provoque de vertige Voltaique (1903) Republished by Paul Cossa in *Ann Méd Psychol*, *198* 325–330, 1950

Cleghorn, R A A comparison of the historical roots and developments in medicine and psychiatry as they affect research. *Canad M A J*, 85 18–27, 1961

Drabkin, D L *Thudichum—Chemist of the Brain* Philadelphia, Univ Penn Press, 1958, 309 pp

Farrar, C B *Portraits* Washington, D C, American Psychiatric Assn, 1958 22 pp

Haymaker, Webb J Godwin Greenfield A neuropathologist s appreciation and bibliography *A.M.A. Arch Neurol & Psychiat*, *80* 590–596, 1958

Jelliffe, S E The psychiaters and psychiatry of the Augustan era *Bull Johns Hopkins Hosp*, *19* 308–312, 1908

McGeer, E G, and P L. McGeer Physiologic effects of schizophrenic body fluids *J Ment Sc*, *105* 1–18, 1959

McIlwain, H Thudichum and the medical chemistry of the 1860s to 1880s *Proc Roy Soc Med*, *51* 127–132, 1958

Overholser, W An historical sketch of psychiatry *J Clin Psychopathol*, *10* 1–18, 1949

Penfield, Wilder *J G Greenfield, M D, 1884–1958 A.M.A Arch. Neurol & Psychiat*, *80* 587–589, 1958

Chapter VII

Allan, T, and S Gordon *The Scalpel, the Sword* Boston, Little Brown, 1952, 336 pp

Best, C H Reminiscences of the researches which led to the discovery of insulin *Canad M A J*, *47* 398–400, 1942
Cattell, H W Tait McKenzie's medical portraits *Internat Clinics* II Series, 35 1–16, 1925
Leys, J F A physical fitness shrine in Canada *Canad M A J*, 82 1330–1332, 1960
McKenzie, R Tait Obituary *Lancet*, 11 June 1938, 1366–7
Malloch, A Dr Thomas McCrae (1870–1935) *Ann Med Hist*, *8* 371–375, 1936
Roddis, L H The poet of Flanders Fields *Ann Int Med*, 6 1657–1662, 1933
Stevenson, Lloyd *Sir Frederick Banting* Toronto, Ryerson, 1946, 446 pp

Chapter VIII

Amulree, Lord Sir James MacKenzie, pioneer of British cardiology *Canad M A J*, *87* 551–558, 1962
Craig, J Francis Adams (1796–1861) *Lancet*, *i* 441–2, 1961
De Jong, R George Huntington *Ann Med Hist*, 9 201–210, 1937
Gunn, C B *Leaves from the Life of a Country Doctor* Edinburgh, Ettrick Press, 1935, 195 pp
Moorman, L J Francis Adams of Banchory (1796–1861) *South Med J*, 29 435, 1926
Moorman, L J William Withering *Bull Hist Med*, *12* 355–366, 1942
Oliver, G, and Sharpey Schafer, E A The physiological action of extract of the suprarenal capsules *J Physiol*, *18* 230–276, 1895
Pasamanick, B Isaac Ray *Am J Psychiat*, *111* 164–171, 1954
Paul, John R Nathan Smith and typhoid fever *Yale J Biol & Med*, 2 168–181, 1930
Pickles, W N Research in general practice *Brit Med J*, *ii* 469–477, 1948
Sarton, G The discovery of the law of conservation of energy *Isis*, *13* 18–44, 1929
Thoms, Herbert The contributions of William Smellie to obstetrics *Am J Obs Dis Women & Child*, *80* 1–10, 1919

Chapter IX

Archibald, E, and G R Brow Experimental production of pancreatitis in animals as a result of resistance of the common duct sphincter *Surg Gynec & Obst*, *28* 529, 1919

Beecher, H K The first anaesthesia records (Codman, Cushing) *Surg, Gynec & Obst*, *71* 689–693, 1940

Bishop, W J *A History of Surgical Dressing* Chesterfield, Robinson, 1959, 90 pp

Brazier, Mary A. B *A History of the Electrical Activity of the Brain* London, Pitman, 1961, 119 pp

Gibson, W C The undergraduate activities of some contributors to neurological science *Yale J Biol & Med.*, *28* 273–284, 1955–6

Gordon-Taylor, G, and E W Walls *Sir Charles Bell—His Life and Times* Edinburgh, Livingstone, 1958, 288 pp

Graham, J M William Harvey and the early days of blood transfusion *Edinburgh Med J*, *60* 65–76, 1953

Johns Hopkins University Collected papers of the graduates of the Johns Hopkins Medical School, 1897–1904 12 vols Baltimore 1897–1904

MacLean, Jay, *et al.* The discovery and early development of anticoagulants *Circulation*, *19* 73–134, 1959

Osman, A. A *Original Papers of Richard Bright on Renal Disease* London, Oxford Univ Press, 1937, 172 pp

Penfield, Wilder The treatment of severe and progressive haemorrhage by intravenous injection *Am J Physiol*, *48* 121, 1919

Talbott, J H Marshall Hall (1790–1857) *J.A.M.A*, *181* 1132–1133, 1962

Tatum, E L Nobel Prize address *Science*, *129* 1711–1719, 1959

Chapter X

Ford, W J John Keats—student of surgery *Quart Bull. Northwestern Univ Med Sch Chicago*, *27* 212–216, 1953.

Guthrie, D Sherlock Holmes and medicine *Canad. M A J*, *85* 996–1000 1961

Klotz, O Albrecht von Haller (1708–1777) *Am Med Hist.*, *8*. 10–26, 1936

McDonough, M L *An Anthology of Medical Poetry Written by Physicians* Springfield, Ill, Thomas, 1945, 210 pp

Marmelszadt, W *Musical Sons of Aesculapius* New York, Froben Press, 1946, 116 pp

Monro, T K *The Physician as a Man of Letters, Science and Action* 2nd ed, Edinburgh, Livingstone, 1951, 259 pp

Norton, R A Anton Chekhov *New England J Med*, *249* 940–942, 1953

Roddis, L H Robert Bridges (1844–1930) *Ann Int Med*, *10* 1028–1032, 1937

Schullian, D, and M Schoen *Music and Medicine* New York, Schuman, 1948, 499 pp

Sherrington, C S *The Assaying of Brabantius and other verse* London, Oxford Univ Press, 1940, pp 38–39, 64, and 86

Sunderman, F W A P Borodin (1834–1887) *Ann. Med. Hist*, *10* 445–453, 1938

Trotter, W *The Collected Papers of Wilfred Trotter* London, Oxford Univ Press, 1941, pp 26–27

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